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ABSTRACT

This guide contains 29 learning modules intended for use by technology teachers and students in grade 8. Each module includes a student laboratory activity and instructor's resource sheet. Each student activity includes the following: activity topic and overview, challenge statement, objectives, vocabulary/concepts reinforced, equipment/supplies, introduction and step-by-step procedure, and evaluation. Among the elements included in the instructor resource sheets are the following: activity topic, essential elements, overview, challenge statement, systems model, critical thinking skills reinforced, teaching tips, instructional strategy, equipment/supplies, evaluation key, support materials, modifications for special needs students, and illustrations. The following are among the module topics: understanding manufacturing, modern plastics, types of business ownership, flow and operations of products in production, quality control, finances and marketing, manufacturing in industrial space stations, space technology, determining construction needs, estimating building materials, understanding foundations, structural materials, home costs and affordability, adapting homes for persons with disabilities, living in outer space, construction careers, building a space station, problem solving, and the work process. Also included are guidelines for using the laboratory activity materials, instructional planning outlines and worksheets, and the common essential elements of an introductory technology course. Many modules are also appropriate for high school students. (MN)

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INTRODUCTORY INDUSTRIAL TECHNOLOGY II

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LABORATORY ACTIVITIES

CE064722

INTRODUCTORY INDUSTRIAL TECHNOLOGY II

Laboratory Activities

By

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Technology Education Curriculum Specialist

Organization of the Laboratory Activity Materials

The major portion of the guide is the compilation of laboratory activity modules. The laboratory activity modules were developed, tested, and reviewed by technology teachers, supervisors, and teacher educators.

Each module includes (1) an instructor's resource sheet and (2) the student laboratory activity.

Each instructor's resource sheet includes the following elements:

- Instructor's resource sheet module number
- Activity topic
- Estimated time
- Essential Elements (common and specific)
- TAAS Objectives
- Activity Overview
- Challenge Statement
- Systems Model
- Interfacing with Other Disciplines
- Critical Thinking Skills Reinforced
- Teaching Tips
- Instructional Strategy
- Equipment/Supplies
- Evaluation Key
- Support Materials
- Modifications for Handicapped, Disadvantaged, and LEP Students—where appropriate
- Illustrations

Each student activity includes the following elements:

- Student activity module number
- Activity topic
- Activity Overview
- Challenge Statement
- Objectives
- Vocabulary/Concepts Reinforced
- Equipment/Supplies
- Introduction (to the activity)
- Procedure (step by step)
- Evaluation

Using the Laboratory Activity Materials

Intended Audience: The material in this guide is designed for use by technology teachers and students in grades seven and eight. Many of the modules, however, would also be appropriate and recommended for use by high school technology programs.

Length of Time for the Materials: The topic of study has been developed to provide materials for 18 to 36 weeks of study. Each module includes a suggested time frame for completion of the activity/module.

Benefits for Teachers and Students: The materials included in this guide were developed to assist technology teachers in planning, organizing, teaching, implementing, and evaluating a technology-based instructional program. The broad exposure students will receive by being involved in the laboratory activities in this guide will enhance their total educational program experience, including their problem-solving skills, creative thinking skills, and social interaction skills, as well as communication, computation, and technical skills.

Flexibility of the Materials: This guide, like other curriculum materials, does not attempt to encompass all situations. Therefore, teachers should supplement the guide with other appropriate ideas, information, and activities as needed in their particular programs.

A key feature in this guide is flexibility. The material may be used in the context of a large class/group approach, a small group approach where appropriate, and, in many of the modules, an individualized approach. In some of the modules, a combination of all three approaches might be incorporated.

Modules should be selected by the teacher in the order that he or she chooses, and the teacher is encouraged to expand or condense the student laboratory activity to meet the needs of addressing essential elements and the time frame designated to cover the topic. Teachers may also need to make substitutions in the use of each module, depending on the equipment, resources, and/or reference materials available.

Essential Elements/TAAS Objectives: Essential elements for Technology Education and TAAS objectives for reading, writing, and mathematics have been identified in each module (where appropriate). As used in this guide, essential element statements represent skills, knowledge, and/or attitudes that imply the ability or intelligence to accomplish an idea, problem, task, job, etc. Essential element statements will assist the teacher in clearly formulating the scope and sequence of the course of study and the purpose and processes for student learning.

Instructional Planning: An instructional planning outline and worksheet are included in the guide for teachers to use in their planning and preparation. The outline and worksheet should prove beneficial to teachers in enhancing their use of various instructional practices, in identifying appropriate teaching behaviors and process decisions, and in documenting teaching techniques selected.

Instructional Planning Outline

Domain I. Instructional Strategies

Criterion 1. *Provides opportunities for students to participate actively and successfully*

Indicator:
a. appropriately varies activities
b. interacts with students in group formats as appropriate
c. solicits student participation
d. extends students' responses/contributions
e. provides ample time for students to respond to teacher questions/solicitations and to consider content as it is presented
f. implements instruction an appropriate level of difficulty

Criterion 2. *Evaluates and provides feedback on student progress during instruction*

Indicator:
a. communicates learning expectations
b. monitors students' performances as they engage in learning activities
c. solicits responses or demonstrations from specific students for assessment purposes
d. reinforces correct responses
e. provides corrective feedback, or none needed
f. reteaches, or none needed

Domain II. Classroom Management and Organization

Criterion 3. *Organizes materials and students*

Indicator:
a. secures student attention, or students are attending
b. uses administrative procedures and routines which facilitate instruction
c. gives clear administrative directions for classroom procedures or routines, or none needed
d. maintains seating arrangements/grouping appropriate for the activity and the environment
e. has materials, aids, and facilities ready for use

Criterion 4. *Maximizes amount of time available for instruction*

Indicator:
a. begins promptly/avoids wasting time at the end of the instructional period
b. implements appropriate sequence of activities
c. maintains appropriate pace
d. maintains focus
e. keeps students engaged

Criterion 5. *Manages student behavior*

Indicator:
a. specifies expectations for class behavior, or none needed
b. uses techniques to prevent off-task behavior, or none needed
c. uses techniques to redirect off-task behavior, or none needed
d. uses techniques to stop inappropriate behavior, or none needed
e. uses techniques to stop disruptive behavior, or none needed
f. applies rules consistently and fairly
g. reinforces appropriate behavior when appropriate

Domain III. Presentation of Subject Matter

Criterion 6. Teaches for cognitive, affective, and/or psychomotor learning and transfer

Indicator:
a. begins instruction/activity with an appropriate introduction
b. presents information in an appropriate sequence
c. relates lesson content to prior or future learning
d. provides for definition of concepts and description of skills and/or attitudes and interests
e. provides for elaboration of critical attributes of concepts, psychomotor skills, and/or attitudes and interests
f. stresses generalization, principle, or rule as a relationship between or among concepts, skills, and/or attitudes/interests
g. provides opportunities for transfer
h. closes instruction appropriately

Criterion 7. Presents information accurately and clearly

Indicator:
a. makes no significant errors
b. uses vocabulary appropriate to students
c. explains content and/or learning tasks clearly
d. stresses important points and dimensions of content
e. clarifies student misunderstanding, or none needed

Criterion 8. Uses acceptable communication skills

Indicator:
a. uses correct grammar
b. pronounces words correctly and clearly
c. uses accurate language
d. demonstrates skill in written communication

Domain IV. Learning Environment

Criterion 9. Uses strategies to motivate students for learning

Indicator:
a. relates content to student interests/experiences
b. emphasizes the value/importance of the activity or content
c. reinforces learning efforts of students
d. challenges students

Criterion 10. Maintains supportive environment

Indicator:
a. avoids sarcasm and negative criticism
b. establishes climate of courtesy and respect
c. encourages slow and reluctant students
d. provides praise for specific performance
e. establishes and maintains positive rapport with students

Domain V. Growth and Responsibilities

Criterion 11. Plans for and engages in professional development

Indicator:
a. shows progress in completing professional growth requirements as agreed upon with appraiser(s), or none needed
b. stays current in content taught
c. stays current in instructional methodology

Criterion 12. Interacts and communicates effectively with parents

Indicator:
a. initiates communications with parents about student performance and/or behavior when appropriate
b. conducts parent-teacher conferences in accordance with local district policy
c. reports student progress to parents in accordance with local district policy
d. maintains confidentiality unless disclosure is required by law

Criterion 13. Complies with policies, operating procedures, and requirements

Indicator:
a. follows statutory and Texas Education Agency regulations
b. follows district and campus policies and procedures
c. performs assigned professional duties
d. follows district promotion/retention policy and procedures

Criterion 14. Promotes and evaluates student growth

Indicator:
a. participates in campus goal-setting for student progress
b. plans instruction in accordance with district requirements
c. documents students progress
d. maintains accurate records
e. reports student progress at appropriate intervals

Instructional Planning Worksheet

Essential Element(s): _____

Teams Objective(s): _____

Curriculum Guide Page: _____

Objective: At the conclusion of the lesson, the learner will be able to:

_____

_____

_____

_____

Focus Activity: _____

_____

_____

a. Task for lesson _____

_____

b. Value of lesson to learner is _____

_____

Explanation / Check Understanding

a. ☐ Lecture ☐ Overhead ☐ Demonstration ☐ _____

b. ☐ Curriculum Guide page _____ ☐ Text page _____ ☐ _____

c. Modeling (teaching will) _____

_____

_____

d. Key questions to check understanding:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Guided Practice Exercise

☐ Exercise copied from overhead ☐ Hand out worksheet no._____

☐ Copy from board ☐ Read sample problems ☐_____

_____

_____

Checking Mastery (Learning Progress)

☐ View each student's work ☐ Students check and signal correct

☐ _____

_____

Independent Practice (Reteach those needing help while others work)

☐ Worksheet no._____ ☐ Copy from overhead ☐ Copy from board

☐ Copy as dictated ☐ Reteach worksheet/outline number _____

☐ _____

☐ _____

Extension (Enrichment/Application)

☐ Worksheet no._____ ☐ _____

Describe how this activity makes relevant application of the lesson: _____

_____

_____

Closure: Restate the learning: _____

_____

Method to involve the learner in the summary: _____

_____

Sponge Activities: Sponge focus activity no._____

Other sponge activity no._____

Introductory Industrial Technology II
Essential Elements

(g) Introductory Industrial Technology II (grade eight, 1/2-one unit). Introductory Industrial Technology II is a laboratory-oriented course that includes the common essential elements for introductory industrial technology plus the following essential elements:

(1) Concepts and skills related to production technology in the area of manufacturing. The student shall be provided opportunities to:

- (A) participate in activities involving product research, design, and marketing;
- (B) investigate resources needed in production;
- (C) use appropriate processes to manufacture a market-ready product;
- (D) apply organization and management systems by planning, organizing, and controlling production processes;
- (E) demonstrate an awareness of automated systems used in manufacturing, including robotics and computer numerical control (CNC);
- (F) recognize basic material standards and terminology used in industry;
- (G) apply primary processes in manufacturing a product;
- (H) use computers in planning, production, quality control, and management of production systems; and
- (I) explore manufacturing systems in a space environment.

(2) Concepts and skills related to production technology in the area of construction. The student shall be provided opportunities to:

- (A) apply organization and management techniques to planning, organizing, and controlling construction;
- (B) use primary construction processes to build a structure;
- (C) explore construction systems, to include containment, shelter, and support;
- (D) explore primary construction techniques;
- (E) explore construction subsystems;
- (F) investigate production trends;
- (G) explore alternative materials, processes, and energy sources in production systems;
- (H) demonstrate techniques and processes used in automated systems, including robotics and computers; and
- (I) explore construction systems in a space environment.

TAAS Objectives

ENGLISH LANGUAGE ARTS

READING COMPREHENSION

1. Determine the meaning of words.
2. Identify supporting ideas.
3. Summarize written texts.
4. Perceive relationships and recognize outcomes.
5. Analyze information to make inferences/generalizations.
6. Recognize points of view, propaganda, and/or fact and nonfact.

WRITTEN COMMUNICATION

Objective
1. Respond appropriately to the purpose/audience in a written composition.
2. Organize ideas in a written composition.
3. Demonstrate control of the English language in a written composition.
4. Generate a written composition which develops and supports a central idea.
5. Recognize appropriate sentence construction.
6. Recognize appropriate word usage.
7. Recognize within the context of a written passage:
   a. the correct spelling of words
   b. correct capitalization
   c. appropriate punctuation

MATHEMATICS

CONCEPTS

Objective
1. Demonstrate an understanding of the concepts of numbers.
2. Demonstrate an understanding of mathematical relations, functions, and other algebraic concepts.
3. Demonstrate an understanding of geometric properties and relationships.
4. Demonstrate an understanding of measurement concepts using metric and customary units.
5. Demonstrate concepts related to an understanding of probability and statistics.

OPERATIONS

Objective
1. Demonstrate skills, concepts, and applications related to addition.
2. Demonstrate skills, concepts, and applications related to subtraction.
3. Demonstrate skills, concepts, and applications related to multiplication.
4. Demonstrate skills, concepts, and applications related to division.

PROBLEM SOLVING

Objective
1. Estimate solutions.
2. Analyze problems and identify solution strategies.
3. Express problems using mathematical representations.
4. Evaluate the reasonableness of problem solutions.

UNDERSTANDING MANUFACTURING

Essential Elements: 75.50(b): 1A, 3A, 3B
TAAS Objectives: Language Arts: RC 1, 2, 4, 5; WC 6

Activity Summary
Through discussion and brainstorming, students will define manufacturing and identify manufactured and nonmanufactured products.

Challenge Statement
Everything you use has been manufactured or processed in some way. We often take industry for granted. A large portion of the jobs in this country come from manufacturing. It is very likely that you will be working in manufacturing or a manufacturing-related job when you get out of school.

The purpose of this activity is to help you understand the range of social and economic benefits associated with manufacturing.

Systems Model
Resources
Students as resources
Teacher as facilitator
Periodicals and newspapers for manufacturing examples

Processes
Brainstorming the definition of manufacturing and its impact on society
Projecting growth and expansion as a result of industry

Application
Student involvement in manufacturing as employee
Student involvement in manufacturing as consumer

Impact
Understanding community growth
Understanding the impact of manufacturing, both positive and negative

Interfacing with Other Disciplines
Language Arts: Students will define new terms through brainstorming, look up definitions in the dictionary, and refer to periodicals and newspapers for impacts of industry.
Social Studies: Students will realize the impact of industry on society through brainstorming and reference to current events.

Critical Thinking Skills Reinforced
Students will make generalizations about manufacturing and apply those generalizations to growth or recession in their own community. Through brainstorming, imagining, and research, they will gather insight into the impact of industry on society.

Teaching Tips

1. Give the students only a couple of minutes to brainstorm the definition of *manufacturing*. They will remember the definition better if you let them come up with it themselves. After they have arrived at a definition, have a student look it up in the dictionary and read it to the class.
2. Identifying things that have been manufactured will be easy. Again, allow only a couple of minutes, and write the ideas on the board.
3. Nonmanufactured items will be harder to identify. Point out that although people are not manufactured through an industrial process, we are certainly "processed." Water is also processed. Air is up for discussion. Again, do not allow the students to get off on tangents. Limit their time.
4. Because this activity is for only one day, you will need to have articles about the impact of the growth and recession of industry available for the students' quick reference. The school librarian would be your best reference.
5. Lead the students to conclusions about growth or recession in your community. They will probably not be aware of the reasons for many of the changes unless they were directly affected (parent getting a new job or being laid off). You can lead them to the understanding from your own insights.

Instructional Strategy

- Open the unit with a discussion of the definition of manufacturing.
- Lead into manufactured and nonmanufactured items to check for understanding.
- Expand the information through the discussion of the impact of manufacturing industry on a community.
- Close the unit by relating the information to your own community.

Equipment/Supplies

1. Dictionary
2. Any manufacturing textbook
3. Periodicals
4. Newspapers

Evaluation Key

Evaluate students according to their behavior and participation during the discussion.

UNDERSTANDING MANUFACTURING

Define manufacturing and identify manufactured and nonmanufactured products, using discussion and brainstorming.

Challenge Statement

Everything you use has been manufactured or processed in some way. We often take industry for granted. A large portion of the jobs in this country come from manufacturing. It is very likely that you will be working in manufacturing or a manufacturing-related job when you get out of school.

The purpose of this activity is to help you understand the range of social and economic benefits associated with manufacturing.

Objectives

- To learn the meaning of the word *manufacture*
- To understand the impact of the manufacturing industry on society, both positively and negatively
- To identify ten or more items in the classroom that have been manufactured

Vocabulary/Concepts Reinforced

- Business
- Industry
- Manufacturing
- Product
- Service

Equipment/Supplies

- Dictionary
- Any manufacturing textbook
- Periodicals
- Newspapers

Introduction

Through discussion and brainstorming, you will define and understand the term *manufacturing*.

Procedure

1. Your teacher will write the word "manufacture" on the board. With the class, discuss the meaning. Come up with a final definition to compare with those of the other classes. Look up the definition in the dictionary to see how accurate your class's definition was.
2. Now brainstorm all the things in the classroom you can see that are manufactured. Count how many your class identified.
3. Look around the room. How many things have *not* been manufactured?
4. Imagine an unpopulated area. An automotive manufacturing plant builds a factory and is hiring 4,000 employees. What will happen to the area? Name all the changes necessary to accommodate the employees and their families.

5. Identify areas in your community that have grown because a particular business has moved in. Can you identify areas in the country or your community that have become depressed because businesses have failed or closed?

Evaluation
You will be evaluated according to your behavior and participation during the discussion. Your input is important.

JIGS AND FIXTURES

Essential Elements:	75.50(b): 1A, 2C, 2D, 4A, 4B, 5A, 5B, 6A, 6B, 6D, 7A, 8A, 8B 75.50(g): 1A-G
TAAS Objectives:	Language Arts: R 1; 2, 4, 5; WC 1-4 Mathematics: C 1-4; O 1-4; PS 1-4

Activity Overview

Your students will design a simple product that requires at least three machine operations and assembly. Then they will design and build the jigs and fixtures to make production easier and more accurate. They will complete the activity with a production run and evaluation of the process.

Challenge Statement

A company has an order for 500 small coaster sets for a fund-raiser. They are excited about the order, but they only have one week to deliver. If they have to measure and mark each part individually for processing, they will not meet their deadline. Fortunately, they can design and build jigs and fixtures to make the job fast and accurate.

Your class will do the same thing in this activity. They will design a simple product, then design jigs and fixtures to make the production job easier.

Systems Model

Resources
Students as designers, engineers, production workers, and evaluators
Instructor as resource person, monitor, and evaluator
Lab equipment necessary to produce the product
Drafting paper and tools

Processes
Brainstorming an item for production
Standard drafting processes
Creative problem solving
Organizing materials, processes, and people
Measuring skills
Materials processing
Evaluating
Drawing deductions and conclusions

Applications
Creativity and problem solving to industrial processes
Organizational skills to problem
Math skills to industrial processes
Teamwork to problem-solving situation
Evaluation and deduction to a real world situation

Impact
Problem-solving processes

The ability to think
Effectiveness of industry
Career choices
Deductive reasoning

Interfacing with Other Disciplines

Language Arts: Students will learn the meaning of new words, sequence activities, and evaluate products according to given standards and requirements.

Mathematics: Students will use measurement in drawing and constructing their products. They will use simple math processes and time to help them make deductions and comparisons about processes.

Science: Students will use problem solving to find a solution and conclusion.

Social Studies: Students will participate in a team to solve problems and learn about industry and work.

Critical Thinking Skills Reinforced

Students will use deductive reasoning and creative problem solving to draw conclusions about industrial processes through this activity. They will design and record information about their solutions through drafting and record keeping. Students will apply their conclusions to real-life industry.

Teaching Tips

1. This is a good activity to tie together safety and simple machine tool and equipment use.
2. Christmas is an excellent time for the activity as the students can make simple gifts or decorations to be shared during the holiday season.
3. If costs will allow, it is good to include a gift for each of the teachers and staff at your school. This is excellent PR for your program. The teachers generally enjoy seeing the efforts of their students in other classes. You could couple the gift giving with an open house during each class period and have the students give the guests a tour of the facility with student demonstrations of activities. Your students will develop pride in the program and the other teachers and parents will develop a much needed awareness of your program.

Instructional Strategy

- Open the class by leading and guiding a brainstorming session.
- Monitor and adjust instruction through the production process.
- Close the activity by encouraging student understanding through questioning and drawing conclusions.

Equipment/Supplies

1. Lab equipment and materials necessary to produce the product
2. Drafting paper and tools

Evaluation

1. As with any thing your students will ever do, they will be evaluated on their behavior and participation.
2. Grade your students on their drawing and dimensions of the product.
3. Grade them on the Jigs and Fixtures Evaluation Sheet, which will vary according to the product each class chooses.

Modifications for Handicapped, Disadvantaged, and LEP Students

Some students may need more time to complete drawings and assistance around equipment. The work assignment may need adjusting to accommodate the individual needs of the students.

Name_____

Jigs and Fixtures Evaluation Sheet

1. How many products did your class produce using jigs and fixtures?

2. How much time did the production run take?

3. How many people were involved in production?

4. What processes used jigs?

   a._____

   b._____

   c._____

   d._____

5. What processes used fixtures?

   a._____

   b._____

   c._____

   d._____

6. What is the difference between a jig and a fixture?

   A jig is_____

   _____

   A fixture is_____

   _____

7. How much time did it take to make one product without jigs and fixtures?_____

8. How much time would it take to make the entire production run without jigs and fixtures? (Show your work.)

   _____

9. Why do you think jigs and fixtures are used in industry?

   _____

   _____

JIGS AND FIXTURES

Design a simple product that requires at least three machine operations and assembly, then design and build the jigs and fixtures to make production easier and more accurate.

Challenge Statement

A company has an order for 500 small coaster sets for a fund-raiser. They are excited about the order, but they only have one week to deliver. If they have to measure and mark each part individually for processing, they will not meet their deadline. Fortunately, they can design and build jigs and fixtures to make the job fast and accurate.

You will do the same thing in this activity. You will design a simple product, then design jigs and fixtures to make your production job easier. You will complete the activity with a production run and evaluation of the process.

Objectives

- To brainstorm a simple item to produce, using a production line process
- To use creative problem-solving skills to design jigs and/or fixtures that are needed to manufacture a product
- To evaluate and compare production processes

Vocabulary/Concepts Reinforced

- Standardized parts
- Trial run (pilot run)
- Gauges
- Plant layout
- Jigs
- Fixtures
- Inventory
- Production line
- Machine processes
- Interchangeable parts
- Quality control
- Job description
- Flow process chart

Equipment/Supplies

- Lab equipment necessary to produce the product
- Drafting paper and tools

Introduction

Because of the large demand for products each day, industry cannot hand-make each one. Production engineers design jigs and fixtures to suit the product being made, to make the production process more efficient and cost-effective.

Jigs guide the path of a tool on a part being produced. *Fixtures* attach to a machine and position the parts being processed. This eliminates the need to measure and mark each part individually. Once the flow of operations is determined and the jigs and fixtures are assembled, production begins.

Procedure

1. With the entire class, brainstorm a small item that will involve at least three machine processes to produce. You will produce one item for each household in your class and/or each teacher in your school.

2. Decide on the dimensions as a class, then individually draw the product using standard drafting practices. Include dimensions. Turn in your drawing for a grade.
3. With your teacher and the rest of the class, determine the processes necessary for production. Design jigs and fixtures that will make production faster and easier.
4. Divide the class into groups. The number of groups will be determined by the number of processes plus two. **Group one** will determine the materials needed for production and complete a Bill of Materials. **Group two** will determine the flow of materials, operations and people and complete a Flow Process Chart. (See Module 8, "The Flow and Operations of Products in Production.") They will set up the production line from the flowchart. The remaining groups will each take one operation and construct the jig or fixture necessary to complete the task.
5. Run one product through the production line to test the operations as a trial run.
6. Your instructor will assign you to a work station. Begin production. Remember, your time is limited. You should see how quickly you can complete production considering high-quality control standards and safety.
7. Evaluate the completed products for standard size, finish, and overall appearance. Did the jigs and fixtures make the job easier? What was your total production time?
8. Divide into your original groups. Each group will now make one product without the use of jigs and fixtures. Multiply the average amount of time it took to make one product by the total number of products made using the jigs and fixtures. How much time would production take without jigs and fixtures? Compare the products from each group. Are they all the same size? Would the parts be interchangeable?
9. Discuss and complete the Jigs and Fixtures Evaluation Sheet. Turn it into your instructor.
10. Discuss automated systems in industry as robots and computer numerical controls on equipment. Understand their importance in the production process.

Evaluation

1. As with any thing you will ever do, you will be evaluated on your behavior and participation.
2. You will be graded on your drawing and dimensions of the product.
3. You will be graded on the Jigs and Fixtures Evaluation Sheet.

TESTING AND IDENTIFYING PLASTICS

Essential Elements: 75.50(b): 2C, 2D, 4A, 4B, 5B, 6A, 6B, 6D, 7A, 7B, 8B
75.50(g): 1A, 1B, 1F, 1G
TAAS Objectives: Language Arts: RC 1-5; WC 1-4
Mathematics: C 1, 2, 4; O 1-4; PS 1-3

Activity Overview

Your students will conduct tests on different plastics samples to determine each one's classification, generic family group, and specific gravity. This will help them realize the many different types of plastics and their various uses.

Challenge Statement

Material identification in any laboratory area is of prime importance. This is especially true of *polymeric material* (chemical compounds with long chains of repeating structural units). To function successfully in the polymeric material laboratory, your students must be able to tell the difference between a thermoplastic and a thermoset. They must also be able to identify generic family groups within each major subdivision. To use the wrong material in a process, or to use a material with lesser characteristics, can prove most costly. Therefore, this assignment becomes one of major importance to the beginner in the polymeric laboratory.

Determining the right materials for a product is of major importance to the manufacturer. Your students need to realize that this is not a minor decision to designers, but is an integral part of the design and production process. This activity will help them understand the sometimes exhaustive research necessary to determine the proper material for a product.

Systems Model

Resources
Students as researchers, experimenters, and designers
Instructor as resource person and monitor
Supplies and equipment necessary to successfully complete the polymeric lab activity

Processes
Lecture, discussion, and demonstration
Burn tests
Heat tests
Specific gravity tests
Record keeping
Deductive reasoning
Designing

Application
Knowledge base to scientific experiment
Results of experiment to material properties and product design
Product concepts to industry

Impact
Product use and development
Responsible manufacturing
Useful products for society

Interfacing with Other Disciplines

Language Arts: Students will learn the definitions of new words and concepts. They will understand the relationship of all plastics, yet determine proper use depending on the specific characteristics of each plastic tested.

Mathematics: Students will use all basic math operations and problem-solving skills to determine the physical characteristics of plastics.

Science: Students will use problem-solving skills to determine the physical properties of a given material.

Critical Thinking Skills Reinforced

Through experimentation, students will analyze and synthesize the material characteristics of various plastics. They will apply their deductions to the application of physical characteristics to the use and purpose of the product.

Teaching Tips

1. "Today's Plastics" (Module 4) is a good prerequisite activity for this unit.
2. Have each student work with a partner.
3. You may be able to borrow a science lab for a couple of days to complete the experiments. The science teacher may trade areas.
4. Remind the students of proper safety procedures when working around a flame. Be sure that all students are working in well-ventilated areas and that they do not inhale the plastics' fumes.

Instructional Strategy

- Open the activity by showing examples of various plastics, and demonstrate the flame test.
- Organize the supplies for each group.
- Closely monitor the students during the activity for safety during the experiment.
- Close the activity with the application of the chosen plastics to a product.

Equipment/Supplies

1. Bunsen burner
2. Sheet metal drip sheet
3. Specimens (3/4" x 3" strips)
4. Scales/weights
5. Drill press
6. Wire
7. Matches
8. Small glass rod
9. Pliers
10. Container of water
11. 1/8" drill for plastics
12. Material Identification Guide

Evaluation Key

Grade your students on the Material Identification Guide—Burn Characteristics sheet and the Material Identification Guide sheet.

Support Materials

1. Baird, R. J. *Industrial Plastics*. South Holland, Ill.: Goodheart-Willcox, 1971.
2. Kazanas, H. D.; Klein, R. S.; and Lindbeck, J. R. *Technology of Industrial Materials*. Peoria, Ill.: Chas. A. Bennett, 1974.

Modifications for Handicapped, Disadvantaged, and LEP Students

Because of the safety risks, a teacher aide would be required to assist students with special needs.

Sample Number_____ Name_____

Material Identification Guide
Burn Characteristics

1. *Color of flame (check one):*
   - _____Blue
   - _____Blue, yellow top
   - _____Green
   - _____Orange
   - _____Yellow (pale)
   - _____Yellow, blue edges
   - _____Yellow, green base
   - _____Yellow, green edges
   - _____Yellow, blue-green base
   - _____Yellow, blue green edges
   - _____Yellow-orange
   - _____Yellow-orange, blue edges

2. *Drippings (check one):*
   - _____Does not drip
   - _____Drips
   - _____Drips in flames

3. *Smoke (check appropriate items):*
   - _____No smoke
   - _____Black smoke
   - _____White smoke
   - _____Thick black smoke
   - _____Green smoke
   - _____Soot
   - _____Thick, black soot
   - _____White ash

4. *Igniting (check appropriate items):*
   - _____Easy to light
   - _____Self- extinguishing
   - _____Burns rapidly
   - _____Burn area becomes transparent
   - _____Difficult to light
   - _____Spurts/bubbles
   - _____Burns slowly
   - _____Chars

5. *Odor:*
   Describe:_____
   _____
   _____

Name_____

Material Identification Guide

Sample #	Sample Description	Classification	Specific Gravity (Show work on back)	Plastic
1				
2				
3				
4				
5				

Description for a product made from sample number_____

Thermoplastic	Flame-Burn, Smoke & Flame Danger	Odor and Respiratory Danger
ABS	Yellow flame, black smoke, drips, continues to burn	Rubber, sharp, biting
Acetal	Blue flame, no smoke, drips, melts, may burn, continues to burn	Formaldehyde
Acrylic	Blue flame, yellow top, white ash, black smoke, popping sound, spurts, continues to burn	Fruit, floral
Cellulose acetate	Yellow or yellow-orange-to-green flame, melts, drips, continues to burn, black smoke	Burnt sugar, acetic acid, burning paper
Cellulose acetate butyrate	Blue flame, yellow top, sparks, melts, drips, dripping may burn, continues to burn	Camphor, rancid butter
Ethyl cellulose	Pale yellow to blue-green flame with blue edge, melts, drips, drips burn	Burnt wood, burnt sugar
Fluorinated ethylene propylene	Melts, decomposes, poison gases formed	Slight acid or burned hair DO NOT INHALE
Ionomer	Yellow flame with blue edge, continues to burn, some black smoke, melts, bubbles, drips burn	Paraffin
Phenoxy	Burns, no drips	Acid
Polyallomer	Yellow or yellow-orange flame, with blue edge, continues to burn, black smoke, melts clear, spurts, drips burn	Paraffin
Polyamides 6, 6	Blue flame, yellow tip, melts and drips, self-extinguishing, froths	Burned wool or hair
Polycarbonate	Decomposes, chars, self-extinguishing, dense black smoke, spurts orange flame	Characteristic, sweet, compare known sample
Polychlorotrifluoro-ethylene	Yellow flame, won't support combustion	Slight, acidic fumes DO NOT INHALE
Polyethylene	Blue flame, yellow top, drippings may burn, transparent hot area, burns rapidly, continues to burn	Paraffin
Polyimides	Chars, brittle, blue flame	
Polyphenylene oxide	Yellow to yellow-orange flame, no drips, spurts, difficult to ignite, thick black smoke, decomposes	Paraffin, phenol
Polypropylene	Blue flame, drips, transparent hot area, burns slowly, trace of white smoke, melts, swells	Heavy, sweet, paraffin, burning asphalt
Polysulfones	Yellow or orange flame, black smoke, drips, self-extinguishing, sparkles, decomposes	Acid
Polystyrene	Yellow flame, dense smoke, clumps of carbon in air, drips continues to burn, bubbles	Illuminating gas, sweet, marigold, floral
Polytetrafluoro-ethylene	Yellow flame, slightly green near base, won't support combustion, self-extinguishing, turns clear	None DO NOT INHALE
Polyvinyl acetate	Yellow flame, black smoke, spurts, continues to burn, some soot, green on copper wire test	Vinegar, acetic acid
Polyvinyl alcohol	Yellow, smoky	Unpleasant, sweet
Polyvinyl chloride	Yellow flame, green at edges, black or gray smoke, chars, self-extinguishing, leaves an ash	Hydrochloric acid
Polyvinyl fluoride	Pale yellow	Acid
Polyvinylidene chloride	Yellow with green base, spurts green smoke, smoky, self-extinguishing	Pungent

Thermosetting	Flame-Burn, Smoke & Flame Danger	Odor, Respiratory Danger
Casein	Yellow flame, burns with flame contact, chars	Burnt milk
Diallyl phthalate	Yellow flame, green-blue edge, self-extinguishing	Acid
Epoxy	Yellow flame, some soot, spits black smoke, chars, continues to burn	Phenolic phenol, acid
Melamine formaldehyde	Difficult to burn, self-extinguishing, swells, cracks, yellow flame, blue-green base, turns white	Fishlike, formaldehyde
Phenolic	Cracks, deforms, difficult to burn, self extinguishing, yellow flame, little black smoke	Phenolic phenol
Polyester	Yellow flame, blue edge, burns, ash and black beads, continues to burn, dense black smoke, no drips	Sweet, bitter-sweet, burning coal
Polyurethane	Yellow with blue base, thick black smoke, spurts, may melt and drip, continues to burn	Acid
Silicone	Low, bright yellow-white flame, white smoke, white ash, continues to burn	None
Urea formaldehyde	Yellow flame with green-blue edge, self-extinguishing	Pancakes

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TESTING AND IDENTIFYING PLASTICS

Conduct tests on different plastics samples to determine each one's classification, generic family group, and specific gravity.

Challenge Statement

Material identification in any laboratory area is of prime importance. This is especially true of *polymeric material* (chemical compounds with long chains of repeating structural units). To function successfully in the polymeric material laboratory, you must be able to tell the difference between a thermoplastic and a thermoset. You must also be able to identify generic family groups within each major subdivision. To use the wrong material in a process, or to use a material with lesser characteristics, can prove most costly. Therefore, this assignment becomes one of major importance to the beginner in the polymeric laboratory.

Objectives

- To study, observe, and experiment with the identification of plastics by a burn test
- To study, observe, and experiment with the identification of plastics by a specific gravity test
- To study, observe, and experiment with the identification of plastics by a heat test using a glass rod
- To become familiar with the different types of plastics and their various uses

Vocabulary/Concepts Reinforced

- Polymeric materials
- Thermoplastics
- Classification
- Thermosets
- Generic family
- Specific gravity

Equipment/Supplies

- Bunsen burner
- Sheet metal drip sheet
- Specimens (3/4" x 3" strips)
- Scales/weights
- Drill press
- Wire
- Matches
- Small glass rod
- Pliers
- Container of water
- 1/8" drill for plastics
- Material Identification Guide

Introduction

When a new product is designed to be manufactured and marketed, it is very important to its success that the right materials be used. Because there are so many different types of plastics with different characteristics and material properties, it is not enough to say that a product will be made of plastic. Researchers and engineers test many types of plastic to be sure that they make their product from the one that will give them the best results. They conduct the same types of tests that you will conduct in this activity. *Be careful when conducting the burn test to work in a well-ventilated area and to avoid inhaling the fumes.*

Procedure

1. Identify each of the samples provided by the instructor.
   a. Major classification (thermoplastic, thermoset)
   b. Generic family group

2. To successfully complete the identification, you will have to perform several basic tests.
   a. Heat test (glass rod)
   b. Burn test
   c. Specific gravity (SG)—the ratio of the density of a substance to the density of some substance (pure water) taken as a standard when both densities are obtained by weighing in air. Use the following formula:

$$SG = \frac{a-b}{(a-b)+(c-d)}$$

   where:
   a = wire and sample in air
   b = wire in air
   c = wire with end in water
   d = wire and sample in water
3. Complete the identification forms provided.
   a. List the burn characteristics.
   b. List the specific gravity (include formula and all data).
4. Choose one of the five plastics you tested. Keeping in mind the type of plastic you chose and the material characteristics, describe the best product that could be made from that plastic. The product can be one that already exists, or it can be one you design yourself.

Evaluation

Your instructor will grade you on the Material Identification Guide—Burn Characteristics sheet and the Material Identification Guide sheet.

Safety Awareness

1. Be careful with hand and machine tools.
2. Avoid inhaling vapors. Work only in a well-ventilated room.
3. Be careful using matches and Bunsen burners.
4. Use cotton gloves when doing the heat test and the burn test.
5. Wear eye protection.

TODAY'S PLASTICS

Essential Elements: 75.50(g): 1B, 1F
TAAS Objectives: Language Arts: RC 1-5; WC 1

Activity Overview
Through this unit, your students will learn about the makeup of plastics and their history. Within their groups, they will brainstorm the many products made from plastic.

Challenge Statement
From jewelry to jets, many common and not so common products are made from plastic. How many products can you identify that are completely plastic or have a plastic part?

Your students will be surprised at the number of products they can identify. By developing an awareness of plastics, your students will mentally review a number of products and materials. Through this activity, they will become aware of the significance of plastics on society and industry.

Systems Model
Resources
Students as brainstormers and investigators
Instructor as resource person and moderator
Plastic products
Study Sheet

Processes
Lecture and study
Brainstorming plastic products
Discussion of impact on industry and society

Application
Awareness of plastics to everyday product use
Material properties and uses to plastics

Impact
Product development
Materials in industry

Interfacing with Other Disciplines
Language Arts: Students will learn the meaning of new words, identify supporting ideas, summarize written text, perceive relationships, and analyze information to make generalizations.
Science: Students will study the properties and molecular structure of plastics.
Social Studies: Students will realize the significance of one material on industry and society.

Critical Thinking Skills Reinforced
Students will apply generalizations about plastics after brainstorming their broad use in industry and society. They will analyze the products and realize their impact on product use in their own lives.

Teaching Tips
1. Make a transparency of the molecular configuration of the plastics and the Types of Products and Their Uses sheet. Discuss both with your students, being sure that they understand the significance of the molecular structure to the properties of the plastic.
2. Divide the class into groups. Challenge them to identify and list as many plastic products as they can in a 10-minute period. You may want to trigger the process by pointing out some of the products in the room, from the clock to the clothes the kids are wearing. Have them read the labels on their clothes, looking for nylon. Once the 10 minutes are up, have them number their list. The group with the greatest number will read its list. The other groups can add the items that were not named from their lists.
3. Discuss the wide variety and uses of plastic products. Speculate what would happen if our supply of crude oil were cut and there was not enough supply to produce plastic. What would we do? Discuss the impact of plastics on industry and society from the job perspective. What new plastics are being developed?
4. Module 3, "Testing and Identifying Plastics," is an excellent follow-up activity for this unit.

Instructional Strategy
- Open the class with a discussion of the transparencies, and check for understanding through the questioning process.
- Monitor the students as they brainstorm products, then lead a discussion on the impact of plastics on industry and society.
- Close the class with the speculation of life with no plastics and the projection of plastics of the future.

Evaluation Key
Grade your students on the number of plastic products they identify within their groups in relation to the rest of the class. For instance, the group with the most items would receive 100, the next group a 97, the next a 94. Explain the evaluation system to encourage the students to stay on task while brainstorming.

Support Materials
1. Baird, R. J. *Industrial Plastics*. Homewood, Ill.: Goodheart-Willcox, 1977.
2. Kasicki, O. *Resources and Projects: A Student Guide to Design and Technology*. Albany, N.Y.: Delmar, 1991.
3. Plastics Education Foundation. *Curriculum Guide for Plastics Education*. Indianapolis: Bobbs-Merrill, 1977.
4. Richardson, T. L. *Modern Industrial Plastics*. Indianapolis: Howard W. Sams, 1974.

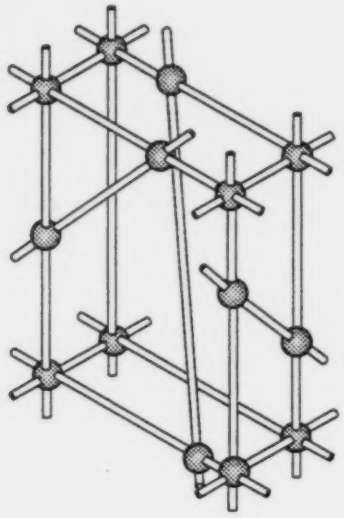


Figure 1. Thermosets have strong rigid bonds with cross-linked supports

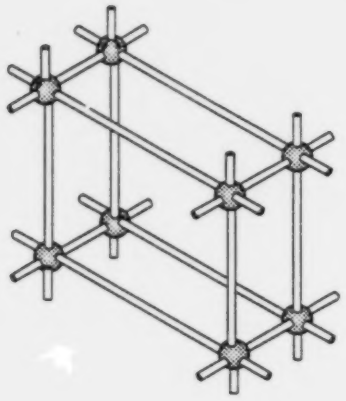


Figure 2. Thermoplastics have a weak rigid bond

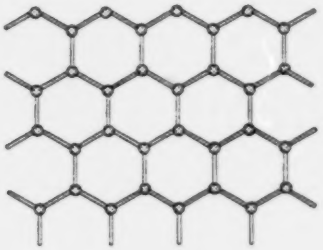
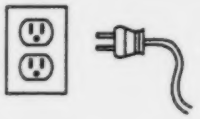
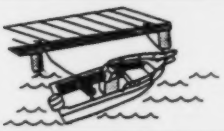
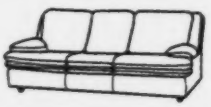


Figure 3. Elastomers have a flexible bond

Types of Products and Their Uses

Type of Plastic		Example of Uses
Thermosets		
Urea formaldehyde		Heat-resistant products Electrical plugs and sockets
Epoxy resin		Glues
Polyester resin		Durable, waterproof materials
Thermoplastics		
Acrylic		Clear, brightly colored reflectors
PVC (polyvinylchloride)		Plumbing pipes LP records
Nylon		Rope, bearings
Polystyrene		Packaging materials
Polypropylene		Crates
Elastomers		
Polyurethane		Foam padding
Butyl		Wiring insulation
Silicone		Electronic components

TODAY'S PLASTICS

Learn about the history of plastics and their molecular makeup, and brainstorm the many products made from plastic.

Challenge Statement

From jewelry to jets, many common, and not so common, products are made from plastic. How many products can you identify that are completely plastic or have a plastic part?

Objectives

- To know the different configurations and uses of plastics
- To identify products made from plastic
- To show the importance of plastic products in society and industry

Vocabulary

- Plastic
- Thermosets
- Fractional distillation
- Thermoplastics
- Synthetic
- Elastomers

Equipment/Supplies

- Types of Products and Their Uses sheet

Introduction

Although the first plastic was produced in 1860, plastics were not widely used in industry until the 1950s. Since then, new types of plastics have been developed, and many new products are being marketed. Many items formerly made from traditional materials are now made of plastic.

Unlike woods and metals, which are found in nature, plastics are synthetic. They are made by the fractional distillation of crude oil in chemical plants. There are three types of plastics: thermosets, thermoplastics, and elastomers.

The structure of thermosets is cross-linked chains, which make the strongest of the plastics (see fig. 1). *Thermosets* do not soften with heat since the molecular chain will break with high temperatures, and the plastic will be destroyed. *Thermoplastics* have weakly cross-linked chains and can be molded and bent when lightly heated (see fig. 2). *Elastomers* have very weak bonds and are flexible and elastic at normal temperatures (see fig. 3). It is because of these different configurations that there are so many different types and uses of plastics.

Procedure

1. Carefully read the information above, and study the figures of the configuration of the three types of plastics. By understanding these configurations, you will be able to understand why one plastic is stronger than the others and why plastics have different uses. Now study and discuss the Types of Products and Their Uses sheet.
2. Take 10 minutes in your group to name all the products you can think of that are made of plastic or have a plastic part. Determine which group has the greatest

number of parts identified. The group with the most products will read the list to the class.

3. Discuss the impact of plastics on society and industry. Consider what your life would be without plastics. What products would you be without?

Evaluation

You will receive a grade on the number of plastic products you identify with your group in relation to the rest of the class.

TYPES OF BUSINESS OWNERSHIP

Essential Elements: 75.50(b): 2A, 3A, 3B
TAAS Objectives: Language Arts: RC 1-5

Activity Overview
Through chart study, discussion, and an entrepreneurship "bee," students will be able to know the three types of business ownerships and identify familiar companies that fall into each category.

Challenge Statement
Business takes money—money to start up and money to operate. Many people who want to start a business do not have enough money, and they do not want to assume all the risk. Because they are unfamiliar with the three options of business ownership, they do not realize they could get the money to start, and they give up on their dream. Many good ideas are lost because people do not know their options.

Systems Model
Resources
Students as potential entrepreneurs
Teacher as presenter and "bee" host
Entrepreneurship Fact Sheet

Processes
Lecture on and discussion of the Entrepreneurship Fact Sheet
Presentation of the list of familiar businesses
Entrepreneurship "bee"

Application
Student involvement in business

Impact
Free enterprise in the United States
Students' options as business owners

Interfacing with Other Disciplines
Language Arts: Students will learn the meanings of new words and supporting ideas.

Critical Thinking Skills Reinforced
Students will gather insight into the concept of business through reading and discussing the fact sheet.

Teaching Tips
1. It would be helpful to make a transparency of the "Entrepreneur Fact Sheet" for review and discussion. Each student should be given a copy. Encourage the class to take notes during the discussion to use during the entrepreneurship "bee."
2. Divide the class into two groups for the "bee."
3. Discuss familiar businesses, and identify their business structure.

4. A test is included for an objective grade.
5. A good follow-up activity is Module 10, "Financial Overview"

Instructional Strategy

- Open the class with a review and discussion of the Entrepreneur Fact Sheet.
- Check for understanding with the entrepreneurship "bee."
- Close the class with a discussion of familiar businesses and their business structure.

Evaluation Key

1. false
2. true
3. false
4. true
5. true
6. true
7. false
8. true
9. true
10. true

Modifications for Handicapped, Disadvantaged, and LEP Students

Some students may need more time to answer their question in the "bee."

Entrepreneurship Fact Sheet

Type of Company	Advantages	Disadvantages
Sole Proprietorship	• Responsible for all decisions • Tax advantages • Keep all profits • No boss • Will not be laid off or get fired • Controls own time	• Responsible for all decisions • Work long hours • Liable for all risks • 90% of all small business fail in first five years
Partnership	• Share decision making • Share work hours • Share losses • Tax advantages • Take vacations with business attended by partner • Share start-up costs • Greater profit potential	• Liable for partner's mistakes • Share profits • Possible personality conflicts
Corporation	• Limited personal liability • Tax advantages	• Limited profit • Limited ownership • High corporate start up costs • May have limited control • Fees • Annual audit • Board of Directors

Raising the money to start the business:

Sole proprietor—must have the money or borrow it and is responsible for all debts and losses.
Partnership—must have the money or borrow it with the partners. The responsibility for losses and debt is shared.
Corporation—the money is raised through the sale of stocks (a certificate giving the holder an actual share of ownership in the company) and/or bonds (a certificate promising the return of money, plus interest, on a specified date). The responsibility for losses and debt belongs to the corporation.

Name_____

Business Ownership Test

Answer each statement true or false. Circle T or F.

1.	A corporation has only one owner.	T	F
2.	The corporation's owners are not personally liable for the company debts.	T	F
3.	In a corporation, the owners' interest in the operation of the company is usually stronger than in a sole proprietorship.	T	F
4.	A partnership is easier to organize than a corporation.	T	F
5.	Money is easier to raise in a partnership than in a sole proprietorship.	T	F
6.	In a partnership, all owners are personally liable for all debt.	T	F
7.	An advantage of a partnership is that the owners may disagree on issues affecting the business.	T	F
8.	In a partnership, all of the owners work together to raise the money necessary to the operation of the company.	T	F
9.	An advantage of a sole proprietorship is that all the profits go to the owner.	T	F
10.	An advantage of a sole proprietorship is that there is only one owner to make the decisions.	T	F

TYPES OF BUSINESS OWNERSHIP

Understand the three types of business ownerships, and identify familiar companies that fall into each category, through chart study, discussion, and an entrepreneurship "bee."

Challenge Statement

Business takes money—money to start up and money to operate. Many people who want to start a business do not have enough money, and they do not want to assume all the risk. Because they are unfamiliar with the three options of business ownership, they do not realize they could get the money to start, and they give up on their dream. Many good ideas are lost because people do not know their options.

Objectives

- To understand the three types of business ownership
- To understand the advantages and disadvantages of the three types of business ownership
- To will know the types of business ownership of familiar companies

Vocabulary/Concepts Reinforced

- Capital
- Corporation
- Entrepreneur
- Liability
- Partnership
- Profit
- Risk
- Start-up costs
- Sole proprietorship
- Stock

Equipment/Supplies

- Entrepreneurship Fact Sheet

Introduction

Some day you may want to have a business of your own. In the early 1900s, 90% of the people owned their own business, and only 10% were employees. In the 1990s, after the Industrial Revolution, the numbers have reversed, and 10% of the people own their own businesses, and 90% are employees. There is a strong trend back to entrepreneurship. One day you could be a successful entrepreneur.

This short activity will teach you the three different ways you could start your own business.

Procedures

1. Review and discuss the Entrepreneurship Fact Sheet.
2. Take notes on the information your teacher reviews.
3. Participate in an old-fashioned "spelling bee." Your teacher will divide the class into two groups. The groups will stand on opposite sides of the room. Your teacher will ask you questions on entrepreneurship one at a time, first one team, then the other. If you get your question right, you will receive extra points (your teacher's choice). The winning team will receive bonus points.

   If you answer incorrectly, you will not receive any points and you must be seated. If you prompt someone or play around, you will sit down and lose any

points you have. Your teacher may let you use the notes you took in class, but not the Entrepreneurship Fact Sheet.

4. Discuss familiar businesses, and identify their business structure.

Evaluation
You will be graded on your behavior during the "bee." You will also receive points for yourself and your team by answering your question correctly.

REPRESENTING A COMPANY NAME, SLOGAN, AND TRADEMARK

Essential Elements: 75.50(b): 2C, 2D, 6A, 6D, 6E (computer application), 8A
75.50(f): 1, 2, 4, 6, 7 (computer application), 17
75.50(g): 1A
TAAS Objectives: Language Arts: RC 1, 2, 4, 5, 6; WC 1

Activity Overview
Students will see themselves as a company and describe themselves with a company name, slogan, and trademark.

Challenge Statement
Literally thousands of companies sell goods and services, and each company wants to be recognized and remembered. One of the best ways to do that is to have a catchy name, slogan, or trademark that attracts people. Companies pay a great deal of money to designers and advertising agencies for just the right slogans and trademarks to represent their companies.

Systems Model
Resources
Students as companies and designers
Teacher as facilitator
Magazines with examples of names, slogans, and trademarks

Processes
Lecture to disseminate information
Sketching and drawing to demonstrate ideas

Application
Student involvement in business organization
Student application of creative ideas

Impact
Creativity
Problem solving

Interfacing with Other Disciplines
Language Arts: Students will learn the meanings of words through practice and problem solving. They will compose creative ideas in a drawn composition.

Critical Thinking Skills Reinforced
Students will use their creative skills to solve a problem. They must design a slogan and a trademark to represent themselves both visually and verbally.

Teaching Tips
1. Review the information in the Introduction on the student activity sheet. Emphasize the traits of good slogans and trademarks. To help the creativity flow, you may get magazines from the library that will have examples of trademarks in advertising.

2. Explain the activity to the students. Pass out the Company Identity Program Form. Most students will talk over their ideas with other students. You will need to emphasize that the end product should be in good taste.
3. If you have a computer graphics program available, allow the students to design their trademarks on the computer.
4. When the students have completed their work, you may want to let them share their ideas with the class. Many of the drawings could be displayed.
5. This unit can be followed with Module 11, "Marketing a Product." They both fall into the marketing area of business.

Instruction Strategy

- Open the unit with a lecture outlining the need for appropriate company names, slogans, and trademarks.
- Expand the idea with examples of colorful ads in magazines.
- The students will practice the concept by designing their own representations.
- Close the unit with an evaluation of the drawings and slogans.

Equipment/Supplies

1. Company Identity Program Form
2. Colored pencils or markers
3. 1/4" grid paper or blank drawing paper
4. Computer and graphics software, if available

Evaluation Key

Students will be evaluated on the completion and neatness of their work.

Company Identity Program Form

Your name_____

Suggested names for your company_____

_____

_____

_____

_____

_____

Suggested Slogans_____

_____

_____

_____

_____

_____

_____

_____

Sketch possible trademarks here (thumbnail sketches). You will choose one of these for a final sketch on separate paper.

REPRESENTING A COMPANY NAME, SLOGAN, AND TRADEMARK

See yourself as a company, and describe yourself with a company name, slogan, and trademark.

Challenge Statement

There are literally thousands of companies that sell goods and services, and each company wants to be recognized and remembered. One of the best ways to do that is to have a catchy name, slogan, or trademark that attracts people. Companies pay a great deal of money to designers and advertising agencies for just the right slogans and trademarks to represent their companies.

Objectives

- To suggest company names
- To create slogans for the company
- To design trademarks for the company
- To understand the importance of positive company representation

Vocabulary/Concepts Reinforced

- Slogan
- Trademark

Equipment/Supplies

- Company Identity Program Form
- Colored pencils or markers
- 1/4" grid paper or blank drawing paper
- Computer and graphics software, if available

Introduction

Everything is endowed with an identity. A familiar signature will call to mind a certain individual and the personal feelings we have about that person. A corporate signature represents what a company does and what it stands for. The corporate name and trademark become the personality of the organization. A single company may be involved in many different fields. Identity becomes essential. The corporate name and trademark are the broadest, most effective means of identification.

As civilization became more sophisticated, a picture of a product became the trademark. Artisans created symbols which served to identify their work.

Today, corporate names, slogans, and trademarks constitute an important part of business. As modern businesses expand worldwide, corporate identity assumes greater significance.

A modern corporate identity program includes three items:

1. The *company name* identifies the company, just as your name identifies you. Examples are General Motors, Ford, Reebok, J.C. Penney, Sears, The Gap, Coca-Cola.
2. A *slogan* is a catchy phrase that makes you think of the product: "The breakfast of champions," "Trix are for kids," "It's the real thing."

3. The *trademark* is a word or symbol or combination of both used to identify goods.

The name, slogan, and trademark should indicate the type of business offered and the products produced.

1. Trademarks and slogans should be simple.
2. They should be easy to read and spell.
3. Names, slogans, and trademarks should be easy to recognize and remember.
4. They should be easy to pronounce.
5. They should be contemporary.
6. They should be in good taste.
7. They should be pleasing to hear.

Procedures

1. In this activity, *you* are a company. Think of how you can best represent yourself visually and through a slogan. What would you call your company using your name? For example, if your last name is Roberts, you could call your company "The Roberts Company," "Roberts and Associates," or "Roberts Enterprises." Use your imagination.
2. Using the Company Identity Program Form, create several company names and slogans for the company that represents you the best.
3. Design several trademarks that say something about you and your interests.
4. Ask other students which they prefer, then choose one for your final drawing.
5. For the final drawing, use drawing paper and colored pencils. Include both the name and trademark. The company name and trademark can be the same, such as with Nike or Reebok.
6. Turn in the Company Identity Program Form and your drawing to your instructor.

Evaluation

You will be graded on the completion and neatness of your work. Your teacher will explain the requirements for your drawing. If you represented an advertising agency with your drawing, how good would you expect it to be to get the account?

NEW PRODUCT DESIGN AND COST ESTIMATION

Essential Elements: 75.50(b): 2C, 2D, 3A, 5A, 5B, 6B, 6D, 8A, 8B
75.50(g): 1A, 1B, 1F, 1G

TAAS Objectives: Language Arts: RC 1, 2, 4, 5, 6; WC 1-4
Mathematics: C 1, 3, 4; O 1-3; PS 1-4

Activity Overview

This activity is concerned with generating ideas and determining product cost. Your students will work in groups to design, sketch and determine the cost of a new product.

Challenge Statement

In manufacturing, *designing* means to create plans for products and systems so that they will be attractive and will perform well. Designers want to create products and systems that will be accepted by customers. All products are designed before being produced. A market survey is generally conducted using a prototype to determine if the product will have consumer appeal.

The cost of the materials to make the item is important in determining the cost the customer will pay for the product. The customer cost must include the cost of materials, operating cost of the business, and profit. Determining cost starts by determining the cost of materials in the product.

In this activity, your students are the designers and engineers. Your job is to assist and direct your students in designing a new product and determining the Bill of Materials for a cost estimate.

Systems Model

Resources
Students as designers and engineers
Instructor as resource person, monitor, and evaluator
Bill of Materials
Preliminary Cost Estimate
Product Idea Development Rating Sheet

Processes
Creative design
Problem solving
Cost analysis
Product evaluation

Application
Creative design to problem solving
Mathematics to bill of materials
Analysis to manufacturing processes

Impact
Consumerism
Career choices
Creative problem solving

Interfacing with Other Disciplines

Language Arts: Students will learn new vocabulary, identify supporting ideas, and recognize the relationship of their design to the elimination of a problem. They will evaluate their designs in a written format.

Mathematics: Students will sketch their designs with dimensions and apply their math skills to estimating the cost of their product.

Social Studies: Students will see the process of design and production as a means of solving problems as it relates to society .

Critical Thinking Skills Reinforced

Students will use problem-solving skills to satisfy a need through product design and development. They will adapt and apply the product to the problem, the marketplace, and the design and manufacturing processes.

Teaching Tips

1. Divide the class into small groups. Have a number of design problems on hand to trigger their imaginations.
2. Make transparencies of the forms to explain to the class as a whole.

Instructional Strategy

- Open the class with an overview of the activity.
- Encourage the students' creativity by presenting design problems.
- Monitor the groups, and evaluate the original design solutions.
- Close the class by allowing each group to present its design problems and product solutions to the class.

Equipment/Supplies

1. Isometric grid paper
2. Product selection ballot
3. Bill of Materials
4. Various materials catalogs
5. 1/4" grid paper
6. Product Idea Developing Rating Sheet
7. Preliminary Cost Estimate form

Evaluation

Grade your students on the sketches of all products, the Bill of Materials, the Preliminary Cost Estimate sheets, and the Product Idea Development Rating Sheet.

BILL OF MATERIALS

Name _____

PRODUCT: _____

PART NO.	NUMBER NEEDED	PART NAME	SIZE H x W x L			MATERIAL

PRELIMINARY COST ESTIMATE

Name _____

QUANTITY	PART OF ITEM	VENDOR A	VENDOR B	VENDOR C	BEST PRICE

VENDORS' NAMES: A: _____ B: _____ C: _____

Product Idea Development Rating Sheet

Name:_____ **Product:** _____

To help you evaluate your product, circle the number on the scale that best evaluates the product you have designed. Include your Bill of Materials in the evaluation. Everyone in your group should complete a separate rating sheet for each product being considered. The product with the highest rating is the one your group should develop.

Statement of the Problem: The Need

_____

_____

_____

(1)	(2)	(3)	(4)	(5)
No statement	Product answers some of the problem			Product meets the need

(1)	(2)	(3)	(4)	(5)
Many design restrictions	Minimal design restrictions			No design restrictions

This Product Offers Multiple Solutions to the Problem Statement:

(1)	(2)	(3)	(4)	(5)
One idea	Two ideas	Three ideas	Four ideas	Five or more ideas

(1)	(2)	(3)	(4)	(5)
Ideas not related to the problem	Most ideas related to the problem			All ideas related to the problem

Selected Idea:

(1)	(2)	(3)	(4)	(5)
Disregards most production criteria	Meets most stated production criteria			Meets all stated production criteria

(1)	(2)	(3)	(4)	(5)
Disregards most marketing criteria	Meets most stated marketing criteria			Meets all stated marketing criteria

(1)	(2)	(3)	(4)	(5)
Disregards most financial criteria	Meets most stated financial criteria			Meets all stated financial criteria

(1)	(2)	(3)	(4)	(5)
Disregards most design criteria		Meets most stated design criteria		Meets all stated design criteria

Cost Data:

(1)	(2)	(3)	(4)	(5)
No Bill of Materials		Partial Bill of Materials		Complete Bill of Materials

(1)	(2)	(3)	(4)	(5)
No material costs listed	Costs listed for most items			Costs listed for all items

(1)	(2)	(3)	(4)	(5)
Few cost entries are accurate	Most cost entries are accurate			All cost entries are accurate

Total points_____

NEW PRODUCT DESIGN AND COST ESTIMATION

Work in groups to design, sketch, and determine the cost of a new product.

Challenge Statement

In manufacturing, *designing* means to create plans for products and systems so that they will be attractive and will perform well. Designers want to create products and systems that will be accepted by customers. All products are designed before being produced. A market survey is generally conducted using a prototype to determine if the product will have consumer appeal.

The cost of the materials to make the item is important in determining the cost the customer will pay for the product. The customer cost must include the cost of materials, operating cost of the business, and profit. Determining cost starts by determining the cost of materials in the product.

In this activity, you are the designer and engineer. Your job is to design a new product and determine the Bill of Materials for a cost estimate.

Objectives

- To generate rough sketches of products
- To generate refined sketches of products
- To rate generated product ideas
- To generate detailed sketches of selected products
- To prepare a Bill of Materials
- To determine preliminary cost estimate

Vocabulary/Concepts Reinforced

- Bill of Materials
- Cost estimate

Equipment/Supplies

- Isometric grid paper
- Product selection ballot
- Bill of Materials
- Various materials catalogs
- 1/4" grid paper
- Product Idea Developing Rating Sheet
- Preliminary Cost Estimate form

Introduction

As a company develops its new products, two basic approaches may be used—a production approach or a marketing approach. In the *production approach,* the product is developed, then a desire to buy the product is created through extensive promotional activities (advertising). In the *marketing approach,* company personnel first determine what the consumer wants, then an attempt is made to meet that need.

There are three important aspects of designing—designing for function, designing for selling, and designing for manufacturing. In *designing for function,* the main consideration involves the product's purpose along with its operation and performance. In *designing for selling,* a designer must make the product appealing to the customer as a primary concern. *Designing for manufacturing* requires the designer to consider simplicity for cost-effectiveness.

Procedures

1. The first activity is idea generation. Your teacher will give you some criteria for a product if you need it, but it will be more fun if your group comes up with an idea on their own. Designers must let their imagination soar as they produce a number of rough sketches.
2. In your group, choose your best two product ideas and make more refined sketches, using the 1/4" grid paper and the isometric grid paper.
   a. The refined sketches are now ready for idea approval. This step may include a product planning committee or the designer's immediate supervisor (instructor).
   b. Choose one product from the ideas which are accepted, and prepare detailed sketches that include dimensions.
3. The developed product is now ready for product design approval. The product is reviewed from the production, financial, engineering, and marketing perspectives by your group and your instructor. Each product must show a strong profit potential.
4. The next step is product engineering. The product design engineers prepare a bill of materials and complete the Bill of Materials form.
5. Using catalogs, students are to complete the Preliminary Cost Estimate form, after the Bill of Materials has been approved by the instructor.
6. Complete a Product Idea Development Rating Sheet for each product. This will determine the best product for manufacturing.
7. Present your designs problems and product solutions to the class.
8. Turn in all your forms to your instructor.

Evaluation

You will be graded on the sketches of all products, the Bill of Materials, the Preliminary Cost Estimate, and the Product Idea Development Rating Sheet.

THE FLOW AND OPERATIONS OF PRODUCTS IN PRODUCTION

Essential Elements: 75.50(b): 2C, 2D, 6A, 6B, 6D, 8B
75.50(g): 1A-D, 1F
TAAS Objectives: Language Arts: RC 1, 2, 4, 5; WC 1, 2, 4
Mathematics: PS 1, 2, 4

Activity Overview

Students will analyze one simple item and one complex item to determine the materials and operations necessary to make the product. At that point, students will determine the sequence of operations and develop a flow process chart.

Challenge Statement

The key to success for any manufacturing enterprise is efficient production. The maximum number of products must be produced for the lowest cost. This includes using materials that meet, but do not exceed, the specifications. This also includes acceptable, but not excessive, tolerance limits, and it means making the best use of labor.

In other words, the production of a product involves getting the right people, the right supplies, the right materials, and the right equipment to the right place at the right time. Your students will be a part of that process by determining the operations necessary to produce a product, and the flow of materials, processes, and people. This will help them understand the specifics of production.

Systems Model

Resources
Students as production engineers
Instructor as resource person and monitor
Operations Sheets and Flow Process Charts

Processes
Demonstration of operations and flow of simple part
Analysis of simple part and product
Determination and documentation of operations
Determination and documentation of flow of operations

Application
Technical knowledge to analysis of operations and sequencing of flow
Sequencing skills to flow of production operations
Product knowledge to manufacturing

Impact
Product knowledge
Production careers

Interfacing with Other Disciplines

Language Arts: Students will understand and establish sequencing in manufacturing processes.
Mathematics: Students will use problem-solving skills to find a solution.

Social Studies: Students will learn the interrelationship of materials, processes, and people. They will better understand skills in the workplace.

Critical Thinking Skills Reinforced
The students will analyze and synthesize to determine the proper sequence of operations in the manufacturing process.

Teaching Tips
1. Students will probably work best with a partner.
2. Organize a number of simple parts and products for evaluation. Have enough so each group will have their own.
3. In the final procedure, help the students compare their charts to determine the correct operations and processes.

Instructional Strategy
- Open the class with a demonstration of a simple part.
- Check the students for understanding of operations and process flow through questions.
- Organize a number of simple parts and products for evaluation.
- Monitor the groups as they assemble their charts.
- Close the class by comparing the results of their analysis and synthesis.

Equipment/Supplies
1. Several manufactured parts
2. Several manufactured products
3. Operations Sheets
4. Flow Process Charts

Evaluation Key
Grade your students on their behavior and participation while working with their partner. An important part of business is working well with others. They learn that process at school. Grade them on their Operations Sheets and Flow Process Charts.

Modifications for Handicapped, Disadvantaged, and LEP Students
Because the students will be working with a partner or in a group, there is no need for modifications.

OPERATION SHEET

Job Description				
Step No.	Description of Operation	Machine	Tools and Equipment	Materials
		61		

FLOW PROCESS CHART

Name _____

Date _____ Score _____

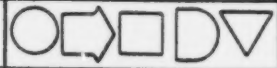
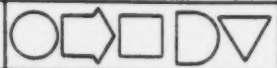
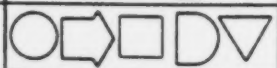
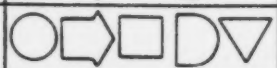
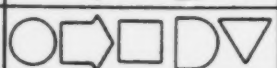
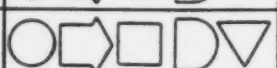
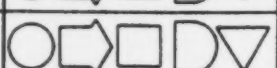
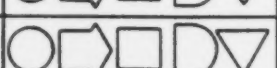
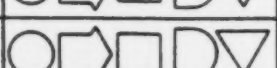
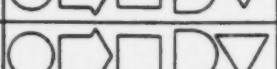
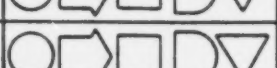
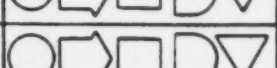
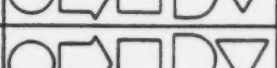
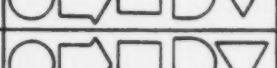
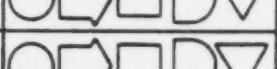
PRODUCT NAME	FLOW BEGINS	FLOW ENDS	DATE

PREPARED BY:	SECTION:	APPROVED BY:

PROCESS SYMBOLS AND NO. USED

OPERATIONS _____ INSPECTIONS _____ TRANSPORTATIONS _____

DELAYS _____ STORAGES _____

Task No.	Process Symbols	Description of Task	Machine Required	Tooling Required
				
				
				
				
				
				
				
				
				
				
				
				
				
				
				

THE FLOW AND OPERATIONS OF PRODUCTS IN PRODUCTION

Analyze a simple and a complex item to determine the materials and operations needed to make the product, then determine the sequence of operations and develop a flow process chart.

Challenge Statement

The key to success for any manufacturing enterprise is efficient production. The maximum number of products must be produced for the lowest cost. This includes using materials that meet, but do not exceed, the specifications. This also includes acceptable, but not excessive, tolerance limits, and it means making the best use of labor.

In other words, the production of a product involves getting the right people, the right supplies, the right materials, and the right equipment to the right place at the right time. You will be a part of that process by determining the operations necessary to produce a product, and the flow of materials, processes, and people.

Objectives

- To analyze a part or a product in terms of required operations
- To analyze a part or a product in terms of required production processes
- To be able to understand the need for proper sequencing of materials, processes, and people in production

Vocabulary/Concepts Reinforced

- Operations
- Flow process chart
- Production line
- Work station
- Resources
- Preproduction run
- Tolerance limits

Equipment/Supplies

- Several manufactured parts
- Several manufactured products
- Operations Sheets
- Flow Process Charts

Introduction

Once it is determined which part or product is to be manufactured, operations must be selected and sequenced. A logical order of operations must be established for each part and for assembly. Operations Sheets are used to describe the major steps or operations required to produce a part. Operations include machining parts, assembling products, heat-treating materials, and applying finishes.

Flow Process Charts expand the information included on the Operations Sheets. The Flow Process Chart adds material movements, inspections, delays, and storage to the operations on the Operations Sheets. Each of these elements has an accepted definition and symbol. A knowledge of these definitions and symbols is essential.

Inspections are conducted to check the size and shape of parts, the location and size of such features as holes and slots, the chemical composition of materials, or the quantity of items received. Inspections must be scheduled, along with quality control, to catch any errors throughout the production process.

Transportation occurs when the material is moved from one work station to another, or into or out of storage. Delays might involve parts in a bin waiting to be processed, finished products waiting packaging, or parts waiting for the next step in the manufacturing process.

All of these steps are an essential part of the overall process. The sequencing of the steps is extremely important to the cost and usefulness of the product.

Procedure

1. Listen as your instructor explains the operation and flow of a simple part.
2. With your partner, take the product your instructor gives you, and analyze all the parts. Determine the operations and flow of operations for the successful processing and assembly of the parts. Fill in the Operations Sheet and Flow Process Chart. Remember to time the parts and processes using all the proper symbols. It may be necessary to delay a part or material at a station to allow the process to run smoothly.
3. Compare your charts with those from other groups analyzing the same product. Discuss any discrepancies you might have. Determine the best plan. Turn in the work for your group. Make sure that everyone's name is on the charts.

Evaluation

You will be graded on your behavior and participation while working with your partner. An important part of business is working well with others. You learn that process at school too. You will also be graded on your Operations Sheets and Flow Process Charts.

QUALITY CONTROL

Essential Elements: 75.50(b): 1A, 2A-2D, 3A, 3B, 4A, 4B, 5B, 6A, 6D, 8A, 8B
75.50(g): 1F, 1G, 2A

TAAS Objectives: Language Arts: RC 1, 2, 4, 5; WC 1-3
Mathematics: C 1-3, 5; O 4; PS 2-4

Activity Overview

Students will work in groups to create a quality control problem for their classmates and then conduct a quality control test that they devise.

Challenge Statement

Cars that are lemons, leads that break continuously on your pencil, toys that break the first time you use them, and stitching that pulls out on your new shoes are all big problems for you and the manufacturer. Products are sold not only through advertising but also through word of mouth and repeat sales. If customers are not satisfied with a product, their word-of-mouth advertising will hurt manufacturing and affect sales.

To avoid this negative impact, all manufacturing enterprises conduct quality control inspections throughout the production process. Your students will be a part of that process in this activity. They will develop an understanding of an important and often overlooked part of the production and construction industry.

Systems Model

Resources
Students as quality control engineers and inspectors
Instructor as moderator and monitor
Various small, inexpensive items in sets of 100
Various hand tools and measurement devices

Processes
Teamwork
Observation and analysis of parts
Adaption of parts to create margin of error
Deductive reasoning

Application
Setting standards to the use of the part
Observation and analysis to quality control standards
Math skills to measurement and margin of error

Impact
Careers
Consumerism
Responsibility of industry to the consumer and society
Safety

Interfacing with Other Disciplines

Language Arts: Students will learn the meaning of new words and concepts, perceive relationships, and analyze information to make generalizations.

Mathematics: Students will set standards and evaluate products accordingly. They will determine percentages based on their findings.

Social Studies: Students will become aware of the impact of quality on products and industry.

Critical Thinking Skills Reinforced

Students will draw conclusions about the impact of quality on industry after conducting and evaluating a quality control inspection. They will gain insight into the responsibility of manufacturers to produce high-quality products.

Teaching Tips

1. Encourage the students to cite examples of poor-quality products they have purchased. Would they recommend the product to a friend or buy another? How does this affect the manufacturer?
2. Expand the concepts to other industries such as pharmaceuticals, auto, food, clothing, recording, medical equipment, and communications.
3. Emphasize the responsibility that industry has toward the consumer and society.

Instructional Strategy

- Collect and organize all the materials before the activity begins.
- Open the class with a review and discussion of the "Introduction" in the student activity.
- Guide and monitor the students as they set up their standards list and conduct their inspections.
- Close the activity with an in-depth discussion of the importance of quality inspections to all types of industry.

Equipment/Supplies

1. Paper clips
2. Washers
3. Rubber bands
4. Various hand tools
5. Measuring devices
6. Nails
7. Screws
8. Tacks
9. Marbles

Evaluation Key

1. Your students are rewarded based on their degree of output and cooperation. In industry, high output and cooperation will help them receive raises and promotions. Setting up the high output and cooperation habit in school will earn good grades with the financial rewards in business later!
2. They will be graded on their Quality Control Evaluation Sheets. The answers will vary.

Support Materials

Any production or construction text

Name_____

Quality Control Evaluation Sheet

1. What item did your group prepare for inspection?_____
2. List your inspection standards

   (1)_____

   (2)_____

   (3)_____
3. What percentage of error did you create in your products?_____
4. What percentage of error did the inspecting group find?_____
5. What do feel is an acceptable margin of error?_____ 0% is not possible.
6. List six industries where you feel high quality standards are most important and explain why.

   (1)_____

   _____

   (2)_____

   _____

   (3)_____

   _____

   (4)_____

   _____

   (5)_____

   _____

   (6)_____

   _____

QUALITY CONTROL

Work in a group to create a quality control problem for your classmates, and then conduct a quality control test that they devise for you.

Challenge Statement

Cars that are lemons, leads that break continuously on your pencil, toys that break the first time you use them, and stitching that pulls out on your new shoes are all big problems for you and the manufacturer. Products are sold not only through advertising but also through word of mouth and repeat sales. If customers are not satisfied with a product, their word-of-mouth advertising will hurt manufacturing and affect sales.

To avoid this negative impact, all manufacturing enterprises conduct quality control inspections throughout the production process. You will be a part of that process in this activity.

Objectives

- To understand the importance of quality control in industry
- To understand the quality control process
- To understand the role of a quality control engineer

Vocabulary/Concepts Reinforced

- Quality control
- Quality control engineer
- Inspection reports
- Margin of error
- Building codes
- Zoning laws
- Go-no-go gauges
- Indicating gauges
- Fixed gauges
- Tooling

Equipment/Supplies

- Paper clips
- Washers
- Rubber bands
- Various hand tools
- Measuring devices
- Nails
- Screws
- Tacks
- Marbles

Introduction

Quality inspections are a must in all manufacturing processes from paper clips to houses to bridges. As a consumer, our spendable dollars are protected by effective quality control inspections; as manufacturers, the investment dollar and the reputation of their business are protected.

Quality control engineers set the standards for their products in the manufacturing industry. These engineer set standards not only for the finished product but also for all aspects of production, from raw materials on. The engineer must be familiar with material properties, design, safety, the needs of the customer, and the intended use of the product. From this information, he/she draws conclusions about durability expectations, materials, and safety, then set standards for production. An engineering degree is required to meet the requirements of the job.

These standards are continuously checked along the production line for any problems that need adjustments. Quality inspections involve three jobs: (1) measuring the part, (2) checking the size of the part to the size on the working drawings, and (3) deciding about the quality of the matching parts. These inspections are done as a random spot check, surveying numerous parts. If the parts are consistently out of size, adjustments must be made in the tooling of the equipment. This is a costly process that needs to be corrected quickly.

Quality control inspectors follow the standards set up by the quality control engineer. Besides visual inspections, two types of gauges are used in the inspection process; (1) indicating gauges and (2) fixed gauges. Indicating gauges are rulers, micrometers, and dial indicators. These all indicate a measurement that can be compared to the working drawing for analysis. Go-no-go gauges are an example of a fixed gauge. This type of gauge is a certain size that matches the size necessary for the fitting part. There is a given tolerance (margin for error) built into the gauge. If it fits, production is "go"; if it does not fit, production is "no go." This type of gauge allows for quick inspections and reduces the change of human error.

Standards for the construction industry are set on state and national levels by building codes and zoning laws. Building codes dictate the types and quality of materials that will go into the structure and the way structures are to be built for safety. Zoning laws tell how land is to be used in different areas, and how the structures are to be occupied and placed.

Besides building codes and zoning laws, individual contractors and architects will set standards, called *specifications* or *specs*, for their own projects. Additional tests may be conducted on the soil for supporting the foundation, on the paint for thickness, or concrete compression for special needs.

All these standards are set to protect the consumer, the consumer dollar, and the environment. The news sometimes reports a situation that is the result of overlooked or ignored quality inspections. We are all familiar with the space shuttle tragedy which involved one minor defective part. That was a tragedy that could have been avoided.

Conscientious manufacturers have strict quality inspections that are well heeded. The quality of their merchandise and the reputation of their company reflect their standards.

Procedure

1. Your teacher will divide your class into groups and give you 100 pieces of an item. You may receive nails, screws, paper clips, or other small items. With your group, determine what you think is important about your part. List three areas of importance, for example, length of a screw, the straightness of a nail, the roundness of marbles, or the flatness of a paper clip. Your list will be the standard for a quality inspection. You may need to draw sketches or working drawings of your expectations.
2. Inspect your items to see how well they meet the standards you have set. Now make *minor* quality defects that will not meet your standard in a few of the items. Be sure they are minor because you want to test your classmates on their accuracy in their quality inspection.
3. Trade your items and your quality standards list with another group. Conduct the quality inspection on their items using the standards they set up. Count the

number of defective parts to find the margin of error. Out of the 100 items how many items, were defective? What percentage is this?

4. Return the results to the original group. Answer the questions on the Quality Control Evaluation Sheet. Discuss the answers with the class. Turn in your paper.

Evaluation

We are rewarded based on our degree of output and cooperation. In industry, high output and cooperation will earn raises and promotions. Setting up the high output and cooperation habit in school will earn good grades with the financial rewards in business later!

You will also be graded on your Quality Control Evaluation Sheet.

FINANCIAL OVERVIEW

Essential Elements: 75.50(b): 1A, 2C, 3A, 6D
75.50(g): 1B, 1F
TAAS Objectives: Language Arts: RC 1, 2, 4, 5; WC 2-4
Mathematics: C 1; O 1, 3; PS 1, 2, 4

Activity Overview

Through lecture, discussion, brainstorming, and role playing, your students will understand the expense involved in starting up and running a business.

Challenge Statement

Business takes money; money to start up and money to operate. Depending on the size of the business, the cost can range from under $100 a month to literally millions to keep the business operating. Many people would like to own their own businesses, but they are often unaware of the continued expense, and after a short time they close their business for lack of funding.

Systems Model

Resources
Students as entrepreneurs
Teacher presenting new information and facilitating
Businesses as resources
Telephone and directory
Financial activity sheet
Evaluation

Processes
Review of types of businesses
Describe financial expenses
Brainstorm hidden costs and solutions
Role-play entrepreneurship
Report fixed expenses
Evaluate student understanding

Application
Student involvement in business
Planning and organization
Product costs

Impact
Career choices

Interfacing with Other Disciplines

Mathematics: Students will use addition and multiplication to determine fixed expenses. They will relate cost to the production of a product. They will fill out a financial sheet.

Social Studies: Students will relate training to income.

Language Arts: Students will record information about industry in a written evaluation.

Critical Thinking Skills Reinforced
Students will make application of generalizations about finances in industry through discussion, brainstorming, and research. They will gather information, organize it, and report their findings both orally and in written form. The students will compare their results and draw conclusions about the role of money in industry.

Teaching Tips
1. You may need to spend time reviewing the three types of business ownership.
2. Facilitate as the students brainstorm expenses. You may want to refer to the Financial Expenses List.
3. You may want to gather information in advance on minimum wage, local union wages, cost of utilities and phones, and businesses willing to talk to your students about expenses.
4. After the students finish their activity sheets, have the students record their product, the number of employees, size of their facility, and their fixed costs on the board for discussion and conclusions. Ask leading questions, such as:
   - Is there a relationship between the number of employees and fixed expenses?
   - What would be the advantages of incorporating robots in your factory?
   - Is there a relationship between the type of job an employee does in industry and his or her income?
   - Does salary relate to the amount of training needed for a particular job?
   - What is the difference between the business end of industry and the production end? Are they both necessary? Is one more important than the other?
   - What would happen to costs if there were a large number of industrial accidents?
5. Have the students complete the evaluation sheet. The students will be graded on their degree of participation and cooperation with the group, and their neatness and accuracy in completing the activity sheet and evaluation.

Instructional Strategy
- Open the unit with a review of the three types of business ownership.
- Through brainstorming, help the students identify all the costs of industry.
- Facilitate the groups as they gather information to complete their activity sheets.
- Close the unit through drawing conclusions about the impact of money on industry based on the information from their reports.

Evaluation Key
1. All items will be checked *except* "customer's transportation."
2. Expenses that occur every month consistently
3. Yes; rent, utilities, car payment, etc.
4. Yes, for R&D, marketing, management, personnel, and balancing the books. This is the planning, organizational, and management end of the business.
5. The cost of the product must go up or the cost of production go down.

Equipment/Supplies
1. Telephone and directory
2. Determining Fixed Expenses Worksheet
3. Newspaper

Modifications for Handicapped, Disadvantaged, and LEP Students
Students with learning disabilities may be encouraged to work as a partnership or a corporation to get assistance with the math calculations. No other modifications are necessary.

Financial Expenses List

Start-up expenses
Facility design and construction
Tools and equipment
Raw materials
Utility deposits

Monthly overhead expenses
Payroll
Mortgage or Lease
Utilities—electricity, gas, phone
Machine maintenance
Taxes
Benefits—Insurance, Sick Leave

Business expenses
R&D
Advertising
Raw materials

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Determining Fixed Expenses Worksheet

Introduction
You are the owner of a production company. You are doing an overview of your company to help determine where all the money goes and how much money you need to make each month before you make a profit. Fill out the following form to determine expenses.

Describe Your Business
Circle the type of ownership: Sole proprietorship, Partnership, Corporation
If you are not a sole proprietor, name the people involved with you._____
_____
_____
What are their roles?_____
_____
What is your product?_____
How many employees do you have?_____
List their job titles, the number employed in that position, and the salary:

Job Title	*Number Employed*		*Monthly Salary*		*Total Cost*
1._____	_____	x	_____	=	_____
2._____	_____	x	_____	=	_____
3._____	_____	x	_____	=	_____
4._____	_____	x	_____	=	_____
5._____	_____	x	_____	=	_____
6._____	_____	x	_____	=	_____
7._____	_____	x	_____	=	_____
8._____	_____	x	_____	=	_____
9._____	_____	x	_____	=	_____
10._____	_____	x	_____	=	_____
11._____	_____	x	_____	=	_____
12._____	_____	x	_____	=	_____
13._____	_____	x	_____	=	_____
14._____	_____	x	_____	=	_____
15._____	_____	x	_____	=	_____

Health insurance cost per employee _____	x number of employees	=	_____
How many phones will you need? _____	Estimated cost / month	=	_____
Average cost of electricity / month		=	_____
Average cost of water		=	_____
Estimated cost of tool maintenance		=	_____
Taxes		=	_____
Transportation expenses, if any		=	_____
How much do you pay per square foot for your space?_____ x _____ sq. ft.=			_____

Estimated Monthly Fixed Expenses_____
This does not include the cost of the raw materials for production of the product!
You may also have R&D, and those costs will vary. There may also be emergencies that will involve payments occasionally.

Name_____

Financial Overview Evaluation Sheet

1. Check the factors that enter into the cost of a product. (Each correct answer earns 4 points, with 64 total points possible.)

_____Utilities in the factory	_____Accidents in the factory
_____Raw materials	_____Business taxes
_____Shipping the product	_____Mortgage or rent payment on the factory
_____Designing the product	_____Packaging the product
_____Customer's transportation	_____Quality control
_____Advertising the product	_____Salary of the president of the company
_____Factory employee's salary	_____Tools and equipment to make the products
_____Factory employee's sick leave	_____Profits of the company

2. What are fixed expenses? (6 points)

3. Do families have fixed expenses? What are they? (6 points)

4. Do all production companies need the "business" part to run smoothly? Why? (12 points)

5. What happens to the cost of a product if the employees receive a 5% pay raise? (12 points)

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FINANCIAL OVERVIEW

Through lecture, discussion, brainstorming, and role playing, understand the expense involved in starting up and running a business.

Challenge Statement

Business takes money—money to start up and money to operate. Depending on the size of the business, the cost can range from under $100 a month to literally millions to keep the business operating. Many people would like to own their own businesses, but they are often unaware of the continued expense, and after a short time they close their business for lack of funding.

Objectives

- To know the basic types of company ownership and the related methods of financing
- To understand the role of money in business and industry
- To be aware of the importance of receiving money for the production of a good

Vocabulary

- Bonds
- Benefits
- Corporation
- Commissions
- Finance
- Fixed expenses
- Liability
- Overhead
- Partnership
- Profit
- Salary
- Sole proprietorship
- Start-up costs
- Stock
- Utilities
- Wages

Equipment/Supplies

- Telephone and directory
- Determining Fixed Expenses Worksheet
- Newspaper

Introduction

One day you could own your own business. In order to be successful you must develop skills of ownership. This activity is designed to help you realize the expense of running a business. Even if you don't want a business of your own, you can be a more responsible employee if you realize the responsibility your employer assumes by owning and running a businees.

Procedure

1. Participate in a discussion about the cost of producing a product from start-up cost to the sale of the product.
2. With the class, review the three types of business ownership: (1) sole proprietorship, (2) partnership, and (3) corporation. Decide what type of business you would like to own.
3. Fill out the the activity worksheet. If you are a sole proprietor, you will work alone. In a partnership, you will work with your partner or partners. If you are forming a corporation, you will need a president, a vice-president, a financial officer, a marketing officer, and a personnel officer. You will have to

determine the product you intend to produce in order to answer the questions accurately.
You may need to make phone calls to answer all of the questions.

4. Briefly describe your product to the class and explain your expenses. Put your final fixed expenses on the board to compare with the fixed expenses of the rest of the class. Consider these questions:
   - Is there a relationship between the number of employees and fixed expenses?
   - What would be the advantages of incorporating robots in your factory?
   - Is there a relationship between the type of job an employee does in industry and his or her income?
   - Does salary relate to the amount of training needed for a particular job?
   - What is the difference between the business end of industry and the production end? Are they both necessary? Is one more important than the other?
5. Complete the evaluation sheet. Remember, neatness counts professionally, and you begin the habit in school!

Evaluation

You will be graded on your participation in the class discussion and your degree of cooperation and input with your group in filling out the financial activity sheet. You will also be graded on the neatness and accuracy of the activity sheet and the evaluation sheet.

In school, you receive good grades for good work; in industry, you receive money and promotions!

MARKETING OVERVIEW

Essential Elements:	75.50(b): 1A, 2C, 2D, 5A, 6A, 6B, 6D, 8A, 8B 75.50(f): 1, 2, 4, 5-7, 17 75.50(g): 1A, 1F 75.85(b): 3, 7
TAAS Objectives:	Language Arts: RC 1-6; WC 1, 2, 3, 4, 6, 7 Mathematics: C 3, 4; PS 2, 4

Activity Overview
Students will take a common pencil and give it a new image through marketing. The class will conduct market research, and design an advertising campaign and practical but catchy packaging to enhance the image of the pencil.

Challenge Statement
Reebok, Nike, Wheaties, Coca-Cola, and Pepsi. There's one thing all these products have in common, and it isn't sports. All of these products have *high visibility* and *customer appeal* because the people who market them have spent a great deal of time, effort, and money on determining consumer appeal, on advertising, and on packaging.

However, many products in the marketplace do not have the same kind of popularity because the public has not become familiar with them through advertising. Some products are so common that they are not advertised. One of these is the pencil. You will make the pencil popular again through advertising and packaging!

Systems Model
Resources
Students as marketing specialists
Instructor as facilitator
Commercial Impact Survey form
Colored drawing paper
Markers and map pencils
Videotape containing several television commercials
Market Survey form
Packaging materials

Processes
Analysis of commercial advertising
Market survey and analysis
Advertising design
Evaluation of advertising and packaging design ideas

Application
Impact of advertising on students as consumers
An understanding of marketing in industry

Impact
Social impact of marketing
Marketing as a career

Interfacing with Other Disciplines

Mathematics: Students will use problem solving through graphic layout and design.

Language Arts: Students will practice all language arts skills through surveying, analysis, planning, and implementation of advertising.

Social Studies: Students will understand the impact of marketing on industry and consumers. They will understand advertising from both sides and realize its impact on society.

Critical Thinking Skills Reinforced

Students will gain insight into the impact of advertising through evaluating the role of marketing on industry. They will gather information through surveying, analyze the data, and design an ad campaign to accomplish their goal.

Teaching Tips

1. Review a video of TV commercials. Discuss target audience, color, audio, message, and layout. Then review magazines for written ads, and discuss. Assign the Commercial Impact Survey for homework.
2. Introduce the concept of marketing. Review the material in the Introduction in the student activity. Emphasize the impact of advertising and its benefit to industry. Discuss the importance of making a market survey to properly plan and design an advertising campaign. Hand out the Market Survey for students to take overnight. Each student should survey at least five people. (You may want your students to design their own surveys.)
3. Divide the class into groups to analyze the Market Survey and begin their campaigns. Give the students pointers about designing good ads. Have them brainstorm what they like in advertising.
4. Talk about the role of packaging. Encourage the students to incorporate advertising and packaging. Allow the students ample time to carry through on their ideas.
5. Have each group present their campaign. You could carry this another step by having each class choose their favorite. Then take all the first choices, and have an impartial class (such as language arts) pick the ad campaign that would attract them to buy.

Instructional Strategy

- Use visual aids (TV commercials) and discussion to introduce the concept of marketing.
- Have students follow through the instruction with the Market Survey and advertising designs.
- Have students evaluate each other by choosing the ads and packaging with the most appeal.

Evaluation Key

Grade the class on the quality of their advertising campaign and their participation and cooperation while working in the group. Also, evaluate the Commercial Impact Survey forms.

Support Materials

1. Dean, H. R. *Manufacturing: Industry and Careers*. Englewood Cliffs, N.J.: Prentice-Hall, 1976.
2. O'Keefe, C. A. M., *Applied General Education Through Technology Education*. Austin: The University of Texas at Austin, EIMC-Educational Resources, 1992.
3. Ray, W. E. *Introduction to Manufacturing Careers*. Bloomington, Ill.: McKnight, 1975.
4. Wright, R. T., and Jensen, T. R. *Manufacturing*. South Holland, Ill.: Goodheart-Willcox, 1976.

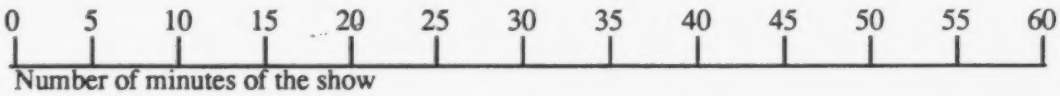
Modifications for Handicapped, Disadvantaged, and LEP Students

No modifications are necessary as the students will be working in groups. Be sensitive in forming the group to work with the special student.

Commercial Impact Survey

View a 30-minute TV program.

1. With your pencil, darken each section that represents the minutes of commercial time. Mark them as they occur during the programing.



2. Check the times when most commercials were shown.

   _____a. during first 0-10 minutes of the show
   _____b. during minutes 11-20
   _____c. during minutes 21-30

3. What was the total number of minutes of commercials?_____

4. What was the total number of minutes of program time? _____

5. What is the ratio of commercial time to TV time?_____ Show work here.

6. Does this surprise you?_____

7. What companies advertised?_____

   _____

8. What age group was targeted by the advertising?_____

9. Why do you think the advertisers chose that group?_____

   _____

10. Would you buy the product?_____

11. How many hours of TV do you watch?
    M_____ Tu____ W_____ Th_____ F_____ Sat_____ Sun_____ Total _____

12. How many minutes of commercials do you estimate that you watch each week? Show your work here.

13. What conclusion can you draw about the impact of TV and commercials? Write on the back of this sheet if you need to.

Market Survey

Date of interview_____

Interviewer_____
Interviewee_____

Complete the following form for the selected product.

Personal Information

1. Age
   - ☐ 11 - 15
   - ☐ 16 - 20
   - ☐ over 20

2. Sex
   - ☐ Male ☐ Female

3. Education
   - ☐ Grade school
   - ☐ High school
   - ☐ College

4. Place of Residence
   - ☐ House
   - ☐ Mobile Home
   - ☐ Duplex
   - ☐ Apartment

Market Information

6. Do you own a similar product?
   - ☐ Yes ☐ No

7. Approximately how many do you own?

8. How long does your product normally last?

9. How much would you be willing to pay?
   - ☐ $0.10/ea.
   - ☐ $0.25/ea
   - ☐ 10 for $1.29
   - ☐ 4 for $0.50

Product Information

10. Would you like the product to be
    - ☐ same size
    - ☐ smaller
    - ☐ larger

11. Would you like the product to be
    - ☐ light color
    - ☐ dark color
    - ☐ bright color

12. What changes would you make, if any?
    _____
    _____
    _____
    _____

MARKETING OVERVIEW

Take a common pencil, and give it a new image through marketing; conduct market research, and design an advertising campaign and practical but catchy packaging to enhance the image of the pencil.

Challenge Statement

Reebok, Nike, Wheaties, Coca-Cola, and Pepsi. There's one thing all these products have in common, and it isn't sports. All of these products have *high visibility* and *customer appeal* because the people who market them have spent a great deal of time, effort, and money on determining consumer appeal, on advertising, and on packaging.

Many products in the marketplace do not have the same kind of popularity because the public has not become familiar with them through advertising. Some products are so common that they are not advertised. One of these is the pencil.

You will make the pencil popular again through advertising and packaging!

Objectives

- To demonstrate the proper use of the market research process
- To analyze survey data
- To know the function of advertising
- To understand the proper use of packaging as an advertising method
- To show concern for our ecology in selection of packaging materials
- To understand the impact of marketing on industry and consumers

Vocabulary/Concepts Reinforced

- Advertising
- Ad campaign
- Consumer audience
- Marketing
- Market analysis
- Market research
- Survey

Equipment/Supplies

- Thumbtacks and staples
- Colored drawing paper
- Markers and map pencils
- Videotape containing several television commercials
- Commercial Impact Survey and Market Survey forms
- Packaging materials

Introduction

Marketing has four functions:

1. *Market research*
   a. Gathers information about the product, the market, and the marketing system.

b. Answers questions about who and where the customers are and what is wanted and needed.
c. Analyzes results of surveys and predicts probable sales potential.

2. *Advertising*
   a. Uses all media to tell the consumer all the features of the product (product advertising): where to buy, how to use, and how to care for.
   b. Persuades persons to act in a desirable way or to have confidence in a name (idea advertising).
   c. Must constantly search out new customers.
   d. Includes packaging that promotes, as well as protects, the product.
3. *Selling*
   a. Sales planning coordinates the plans of suppliers, wholesalers, retailers, and salespersons to get the right product to the right consumer at the right time.
   b. The salesperson must know the product, understand the needs of the customers, keep accurate records, and have a pleasing personality.
4. *Distribution*
   a. Storing, inventorying, and transporting are all part of distribution.
   b. Product support involves installation, maintenance, repairing, and altering or replacing.

You will revitalize the image of the pencil through using the first two functions of marketing.

Procedure

1. To move the product from the producer to the consumer, your company needs a marketing plan. Your marketing program must include market research to be successful. The research survey will study potential customers for your pencil sells. Using the Market Survey and drawings, and examples, survey five people about the product. You are not to survey anyone in this class. The survey will help you determine the group of people who will want and use your product the most. This will determine who the audience will be for your advertising and the type of ads to make.
2. Watch the video of clips of TV commercials to decide what you think is good in advertising. Look through magazines to get the same information. Take written notes of good ideas. You will complete the Commercial Impact Survey for homework.
3. Your teacher will divide the class into groups. With your group, analyze your surveys to determine the audience for your campaign and suggestions about product information. From this information, you can begin to design your advertising.
4. You will want to design a TV ad, a radio ad, a magazine ad, and an attractive and protective package for your product. If your group is large enough, you may want to choose one type of ad to design for each student.
5. Submit your groups ads to the class.

Evaluation

You will be graded on the quality of your advertising campaign and your participation and cooperation while working in the group. You will also be evaluated on the Commercial Impact Survey sheet.

INITIATION INTO SPACE

Essential Elements:	75.50(b): 1C, 1D, 3A, 4A, 5A, 6A, 6B, 6D, 7A, 7B, 8A, 8B 75.50(g): 1A-C, 1G, 1I, 2B, 2E-G, 2I
TAAS Objectives:	Language Arts: RC 1-6; WC 1-4 Mathematics: C 2-4; PS 1, 2, 4

Activity Overview
Through this activity, your students will learn about the history of space exploration. They will have the opportunity to learn about, design, and build a simple satellite.

Challenge Statement
What's hiding under your bed or in your closet in the dark of night? Ever since we were little children, we've been curious. Curiosity doesn't leave us, it just changes directions.

What's in the sky? Is there really a man on the moon? Life on other planets? Because of curiosity, explorers have discovered and developed nearly all parts of the world. Now outer space is our next frontier.

From our space travel we have learned more about ourselves and the earth. We have learned many ways to make outer space useful. Satellites were the first step to opening a whole world of knowledge. How do we use satellites? What do they look like?

Through learning the history of space exploration and travel, your students will be able to understand the usefulness of outer space to our society. They will have the opportunity to design and build a satellite model.

Systems Model
Resources
Students as researchers, designers, and builders
Instructor as resource person, monitor, and evaluator
Reference materials for historic research
Supplies necessary to build a satellite model

Processes
Historic research
Study of satellite usefulness
Satellite design
Satellite model production
Satellite model evaluation
Construction comparisons

Applications
Research skills to space history
Creative design skills to satellite design and production
Technology to societal needs

Impact
Growing and changing needs of society
Space exploration and development
Career choices

Interfacing with Other Disciplines

Language Arts: Students will research the history of space exploration and flight. They will describe a satellite they design and its purpose, in writing.

Mathematics: Students will build a model of a satellite they design and sketch. They will demonstrate an understanding of measurement, and geometric properties and relationships.

Science: Students will understand the significance of space exploration and satellite development to science.

Social Studies: Students will recognize the drive toward space exploration as the development of a new territory. They will identify the societal needs met by satellites in space.

Critical Thinking Skills Reinforced

Students will research the history of space flight and record the information. They will design a satellite and define its use in writing. They will then construct the satellite from the available materials. The class will appraise the satellites according to their function, design, and appearance.

Teaching Tips

1. Prepare a transparency and handouts of the Space History Challenge Sheet to discuss with the class. You may want to check out books from the school library for reference. Make a transparency of the drawing of the Edwin P. Hubble Space Telescope Satellite to discuss with the class. NASA will send materials free of charge to use as supplemental information.
2. Limit the time the students spend constructing the satellites. Point out that all businesses and industries have deadlines. Evaluate the better satellites as a group. Allow the students to determine what they feel is the best design.
3. Compare construction materials used in space with the materials we use on earth.

Instructional Strategy

- Open the class with the Space History Challenge Sheet.
- Lead a discussion on the history of space flight.
- Stimulate the students' creativity with a discussion of all the many uses of satellites.
- Monitor the students as they design and build their satellites.
- Close the class with an evaluation and discussion of a sampling of the finished product.

Equipment/Supplies

1. Encyclopedias and other reference materials
2. Large and small frozen drink cans
3. Toilet tissue and paper towel rolls
4. Straws
5. Paper clips
6. Blank paper
7. Tape and glue
8. Scissors
9. Rubber bands

Evaluation Key

You will evaluate your students on the accuracy of their Space History Challenge Sheet. In most areas of design and development, research is necessary. This will give them experience.

They will also be graded on their model satellite. How well does it match the sketch? How well does the design suit its purpose? How good is the workmanship?

Space History Challenge Sheet Key

1. Soviet Union
2. National Aeronautics and Space Administration; Eisenhower
3. a human
4. Yuri Gargarin
5. Alan Shepard; Freedom 7
6. Gemini; Kennedy
7. Extra Vehicular Activities; 1965
8. put a human on the moon
9. 1967; Gus Grissom, Edward White, and Roger Chaffee
10 1969; Armstrong; Aldrin
11. Skylab; conduct experiments in outer space; study the effects that an extended time in outer space would have on humans
12. 1975; United States; Soviet Union
13. Space Shuttle
14. Columbia; Challenger; Discovery; Atlantis
15. a lunar colony

Support Materials

NASA Resource Centers
Attn: Teacher Resource Center
Mail Stop: 204-7
Moffet Field, CA 94035
(415) 694-6077

1. Bernhardt, L. J., and McHaney, L. *Space Simulation.* Albany, N.Y.: Delmar, 1992.
2. Fales, J., et al. *Technology Today and Tomorrow.* Mission Hills, Calif.: Glencoe, 1992.
3. Hacker, M., and Barden, R. *Technology in Your World.* Albany, N.Y.: Delmar, 1992.

Modifications for Handicapped, Disadvantaged, and LEP Students

Students may need to work with a partner to complete the worksheet. Because of the time limit in constructing the satellite, the students may need help or allowed extra time.

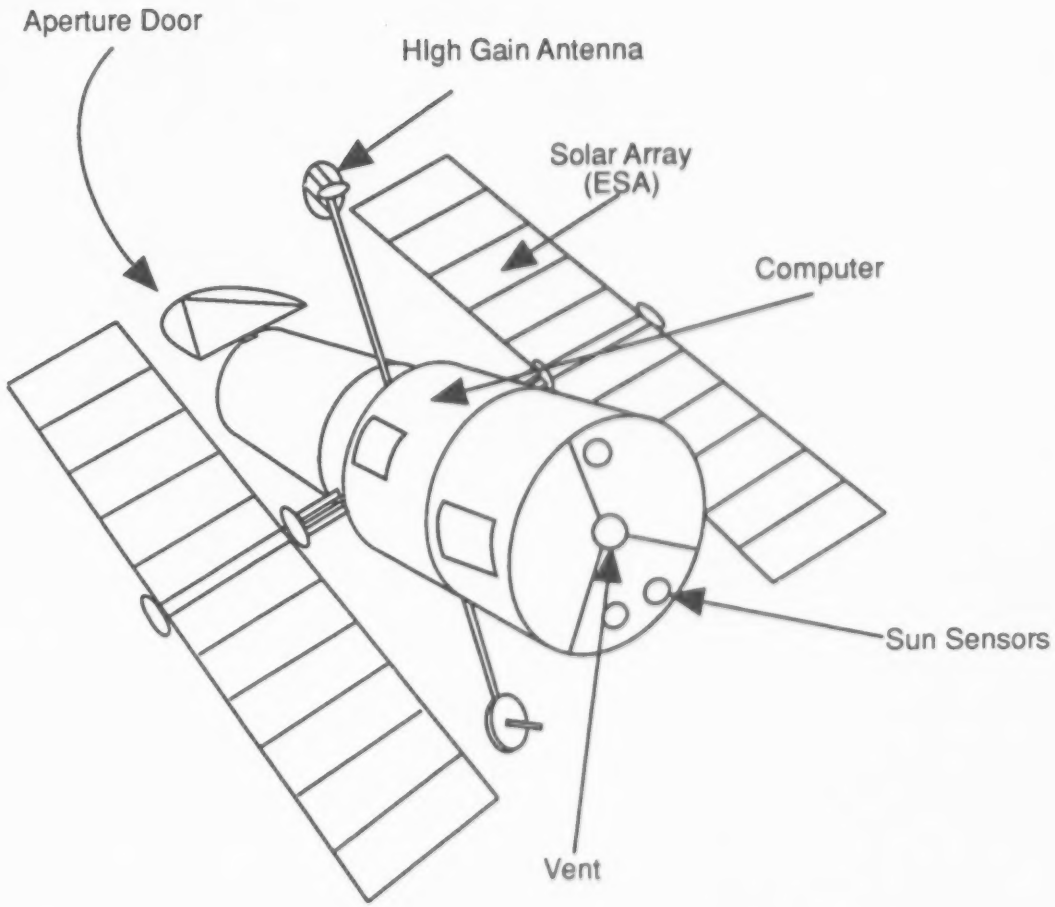
Name_____

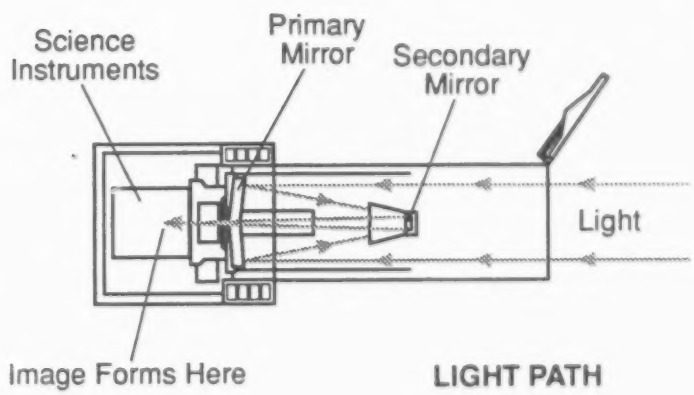
Space History Challenge Sheet

1. The first artificial satellite was successfully launched by the _____.
2. The act establishing NASA, the _____, was signed by President Dwight _____ in 1958.
3. The objective of the Mercury Project (1958) was to put _____ in space.
4. _____ was the first man to circle the earth in the Vostok I on April 12, 1961.
5. Less than one month later, on May 5, 1961, _____ was the first American in space aboard the _____.
6. The_____ Project was established after President _____ stated America's pledge to put a man on the moon before 1970.
7. EVAs , _____, unmanned lunar probes, space rendezvous, dockings, refuelings, and orbiters sending back pictures were all tested in March of _____, on the first Gemini mission.
8. The goal of the Apollo Project was to _____ .
9. On January 27,_____, three astronauts were killed when the command module of the Apollo I caught fire. They were _____, _____, and _____.
10. On July 20, _____Neil _____and Buzz _____landed on the moon.
11. After the Apollo Project, _____was developed as a more permanent orbital research station close to earth. Its purpose was to _____ and to _____.
12. On July 15, _____, two countries launched manned spacecraft separately, then rendezvoused in space. They were the _____ and the _____.
13. The _____ _____ is a reusable space vehicle.
14. The four space shuttles are the _____, the _____, the _____, and the _____.
15. The purpose of Space Station Freedom is to establish _____

_____.

Hubble Space Telescope





LIGHT PATH

INITIATION INTO SPACE

Learn about the history of space exploration and about design, and build a simple satellite.

Challenge Statement

What's hiding under your bed or in your closet in the dark of night? Ever since we were little children, we've been curious. Curiosity doesn't leave us, it just changes directions.

What's in the sky? Is there really a man on the moon? Life on other planets? Because of curiosity explorers have discovered and developed nearly all parts of the world. Now outer space is the next frontier.

From our space travel we have learned more about ourselves and the earth. We have learned many way to make outer space useful. Satellites were the first step to opening a whole world of knowledge. For what would you design a satellite? What would it look like?

Objectives

- To become familiar with the history of space flight
- To learn the many uses for satellites
- To design and build a model satellite
- To project the uses of satellites in the future

Vocabulary/Concepts Reinforced

- Geostationary
- Uplink
- Downlink
- Communication satellite
- Repeater
- Earth station
- Microwaves
- Scramble
- Encoder
- Decoder

Equipment/Supplies

- Encyclopedias and other reference materials
- Large and small frozen drink cans
- Toilet tissue and paper towel rolls
- Straws
- Paper clips
- Blank paper
- Tape and glue
- Scissors
- Rubber bands

Introduction

America's first satellite was the Explorer, built in 1958. Since then, satellites have changed the face of communications and scientific research along with any number of other areas. With the advances in technology, satellites are being used in an ever-increasing capacity, including, in science, extensive mapping of the earth and other planets; tracking crops, forests, snow covers, flooding, earthquakes, and pollution; predicting the weather. Telecommunications is an area that is highly affected through live news broadcasts, and phone, radio, and TV communications. Military intelligence and security has been strengthened

through satellite surveillance. Satellites have provided a greater opportunity for medical research, data collection, and dissemination. New products are being designed, researched, and produced in outer space in satellite workstations. The uses are only limited by the imagination.

Procedure

1. Build a working foundation of space history by researching, discussing, and completing the Space History Challenge Sheet. What challenges and risks were involved with exploring space? Are the same risks ongoing? What are the rewards that make the risks worthwhile?
2. Determine the purpose of the satellite you will build. Is for manufacturing, research, communications, or surveillance? Write a brief description of your satellite.
3. Study the drawing of the Edwin P. Hubble Space Telescope Satellite. Sketch your design, keeping in mind the supplies available to build your model.
4. Build your model in one class period. Remember, even NASA has deadlines.
5. Display all the models with their descriptions. Evaluate a sample of the satellites. How does construction differ in outer space? What materials are used in construction in space as compared to construction on earth?
6. Discuss the future uses of satellites and the impact of satellites on society.

Evaluation

You will be evaluated on the accuracy of your Space History Challenge Sheet. In most areas of design and development, research is necessary. This will give you experience.

You will also be graded on your model satellite. How well does it match your sketch? How well does the design suit its purpose? How good is your workmanship?

MANUFACTURING IN AN INDUSTRIAL SPACE STATION

Essential Elements:	75.50(b): 1A, 2A, 2C, 2D, 3A, 4A, 4B, 5B, 6A-E, 7B, 8A, 8B 75.50(g): 1A-I, 2F-I
TAAS Objectives:	Language Arts: RC 1-6; WC 1-4 Mathematics: C 1, 3, 4

Activity Overview
The students will study the different types of manufacturing in outer space. They will learn the advantages that manufacturing in a weightless environment offers.

Challenge Statement
How can we manufacture a perfectly round ball bearing? Or a pure lens for a telescope? Or a pure glass cable for communications? We do a fairly good job on earth, but much purer and more accurate products can be made in outer space.

This activity will challenge your students to understand the limitations and advantages of manufacturing in a space environment.

Systems Model
Resources
Students as researchers, experimenters, and reporters
Instructor as resource, monitor, motivator, and evaluator
Supplies and equipment necessary to conduct the experiments
Reference materials

Processes
Researching the conditions of outer space
Conducting experiments
Casting and molding
Designing construction tools to use in outer space
Reporting
Evaluating

Application
Research skills to technology
Production skills and knowledge to experimentation
Design to futuristic tools
Recording, reporting, and evaluating skills to deductions about manufacturing in outer space

Impact
Problem solving
Teamwork
Careers
Technological developments

Interfacing with Other Disciplines

Language Arts: Students will learn the meanings of new words. They will give oral and written reports and listen to reports from their classmates.

Science: Students will learn about the conditions in outer space and about how to adapting to those conditions.

Social Studies: Students will learn about work in an alien environment.

Critical Thinking Skills Reinforced

Through cooperative teaching, the students will analyze and extend information about space industrialization through researching, experimenting, recording information, and reporting. They will appraise information from other groups and consider the benefits of manufacturing products in space.

Teaching Tips

1. Any of the other activities on outer space would enhance this information.
2. You may allow the students to choose their groups, then assign those who do not have a preference. You will probably not need more than two or three students in the research group. They could go to the school library for reference materials. Encourage them to report on current developments in space technology.
3. You will need more students in group 3, which is probably where most students will want to be. Experiment #1, mixing liquids, will only need two or three students. Experiment #2 will need three or four (no less than three), depending on the number of blowers you have. Experiment #3 can have as many stations as you can accommodate. The students can make, or try to make, alloys from different metals.
4. Spend only one day in groups.
5. Discuss what would be involved in getting a job in the space program.

Instructional Strategy

- Organize all supplies and equipment before the class begins.
- Open the class by reading and discussing the "Introduction" in this activity.
- Monitor the students throughout the research, design, and experimentation phase.
- Close the activity with an evaluation and discussion of the results from all three groups.

Equipment/Supplies

1. Heating, casting, and molding equipment
2. Scrap lead and aluminum
3. Oil, water, and vinegar
4. Glass containers with lids and labels
5. Balloons and three or four hair dryers
6. Drafting paper and tools
7. Reference materials

Evaluation Key

You will grade your students on group input, the oral report to the class, and the written report from the group.

Support Materials

NASA Resource Centers
Attn: Teacher Resource Center
Mail Stop: 204-7
Moffet Field, CA 94035
(415) 694-6077

1. Bernhardt, L. J., and McHaney, L. *Space Simulation*. Albany, N.Y.: Delmar, 1992.
2. Fales, J., et al. *Technology Today and Tomorrow*. Mission Hills, Calif.: Glencoe, 1992.
3. Hacker, M., and Barden, R. *Technology in Your World*. Albany, N.Y.: Delmar, 1992.
4. Komacek, S. *Production Technology*. Albany, N.Y.: Delmar, 1992.
5. Ritz, J., et al. *Exploring Production Systems*. Worcester, Mass.: Davis Publications, 1990.

Modifications for Handicapped, Disadvantaged, and LEP Students
Because the students are working in groups, no modifications are necessary.

MANUFACTURING IN AN INDUSTRIAL SPACE STATION

Study the different types of manufacturing in outer space to learn the advantages that manufacturing in a weightless environment offers.

Challenge Statement
How can we manufacture a perfectly round ball bearing? Or a pure lens for a telescope? Or a pure glass cable for communications? We do a fairly good job on earth, but much purer and more accurate products can be made in outer space.

Objectives
- To understand the advantages of manufacturing products in space
- To learn the variety of products that will be produced in space and why

Vocabulary/Concepts Reinforced
- Industrial spacecraft
- Microgravity
- Ilmenite
- Photovoltaic
- Canadarm
- Levitators
- Superalloy
- Fiber optics
- Crystals
- Silica
- Microspheres

Equipment/Supplies
- Heating, casting, and molding equipment
- Scrap lead and aluminum
- Oil, water, and vinegar
- Glass containers with lids and labels
- Balloons and three or four hair dryers
- Drafting paper and tools
- Reference materials

Introduction
Space industrialization is no longer a wave of the future; it is happening now. With the fast pace of developing technology, we are able to design and build an industrial space station that will house equipment to collect information, conduct experiments, and manufacture new products.

Space industrialization involves three phases. The first involves **basic scientific research** to determine the effects of the alien environment on humans and equipment, and to ascertain the advantages and opportunities the environment provides. What challenges does a weightless, oxygen-free environment present?

The second phase involves **designing tools and equipment** that can be used in outer space. Microgravity sets up much different conditions in space than on earth where you are working with gravity. For instance, you can tighten a bolt with a ratchet wrench on earth with very little difficulty. In outer space, however, when you turn the wrench, *you* also turn; there is no gravity to hold you down. Many similar challenges will require new innovative tools to accomplish the job.

The third phase involves the actual **manufacture of new products**. Whereas the environment provides challenges in setting up the industrial space station, the conditions in outer space provide opportunities and advantages for manufacturing. On earth, gravity sets limitations on the types of materials that can be mixed due to separation because of weight. An example is oil and water. In outer space, the materials have no weight and do not separate. Weightlessness will allow us to manufacture new alloys with advantages over earth-made materials.

Microgravity also has another advantage. Perfectly round beads and bearings can be produced in exact sizes. Millions of microspheres (1/2,500 of an inch) can be produced that are all exactly the same size and perfectly shaped. They can be used for calibrating equipment and measuring products accurately.

Because the space atmosphere is free of impurities, purer glass can be made for fiber optics, and purer, more uniform crystals can be grown for computers.

Raw materials will be brought to industrial space stations on the space shuttle. The space station will be recovered and attached to the cargo area of the shuttle with a "Canadarm" or remote manipulator system to provide a working atmosphere for the astronauts. They will supply the raw materials, check out and set up the equipment, and pick up any finished product. At that point, they will release the space station and return to earth while robots and computers do the work in the space station. They will return every month or two to repeat the process.

As new materials are being developed in space, new uses for them are being developed on earth!

Procedure
Your groups will follow the same three phases as the space industrialization program: research, design, and production.

You may be allowed to choose your group, or your teacher will assign you to one. Each group must:

1. research, design, or experiment.
2. give an oral report to the class.
3. turn in a written report.

Group 1: You will research the differences in the environment in outer space, and report the problems astronauts face in that environment. You will also research and report on solutions that have been designed and developed for the problems. How will the moon mineral ilmenite be used? What are the most recent discoveries and innovations?

Group 2: You will design tools and equipment that could be used in outer space to make work easier for astronaut construction workers. Draw your ideas according to the standards your teacher sets. If you have CAD available, use it. Display your designs with a written description of the tool or equipment and its use.

Group 3: You will conduct experiments on simple materials to help you, and the rest of the class, understand limitations on earth and advantages in outer space for manufacturing.

The first experiment is very simple. Mix several different liquids in labeled glass containers. Let them sit. Which liquids mix? Which do not? Time how long it takes the liquids to separate. Record your results. Set these aside to demonstrate to the class later. Who would benefit from mixing liquids that do not separate. If they were brought to earth as liquids, would they remain mixed? Why?

Experiment two will take time and patience. One method for mixing pure materials in outer space is by floating them in space rather than mixing them in a container that might have impurities. A levitator will keep the material suspended in one place with the use of sound waves. This process provides the medium for making microspheres.

For your simulation, you will use air pressure and a balloon to make a levitator. Blow up a balloon. Use three or four people with blowers or hair dryers to keep the balloon suspended in one place. Does the difference in air pressure make it difficult? Do you have to stand at different distances from the balloon to keep it in one place? What happens when someone moves? Demonstrate this process to the class, and explain all the variables. Do you think this would be easier with sound waves? Why?

The third experiment is more complex. Work with your teacher to melt small amounts of lead shavings and aluminum. Mix the two metals, and cast them in a simple mold. Let your product cool, then remove the mold. What do you have? Do you have a true alloy? Why? How could recycled materials be used?

As a class, discuss the limitations and benefits of manufacturing products in outer space. What is the main motivation for the endeavor? What is the relationship between, research, design and manufacturing?

Evaluation

You will be graded on your input in your group, the oral report to the class, and the written report from your group.

"GOT IT! SPACEWALKERS GRAB SATELLITE"

Essential Elements: 75.50(b): 2A-D, 3A, 6D, 7B
75.50(g): 1I
TAAS Objectives: Language Arts: RC 1-5; WC 1-4

Activity Overview
Through evaluating a true-life space adventure, your students will draw conclusions about the qualifications and training an astronaut needs. They will also understand the role of business and industry in space development, and realize the need for excessive quality control requirements.

Challenge Statement
Due to a miswired booster rocket, a $157 million satellite was left in the wrong orbit and will burn up in the atmosphere. A faulty gasket in the fuel line caused the loss of seven lives in the Challenger explosion. Could proper inspections avoid disasters, saving lives and money?

In spite of the dangers, space exploration and development continues at a fast pace. What is the motivation to participate in a high-risk, life-threatening occupation? What qualifications do people need to be astronauts? What training is required?

As your students consider these questions, they will begin to understand profit motive and the importance of quality control and good workmanship.

Systems Model
Resources
Newspaper report
Students to gather insight
Teacher as moderator

Processes
Reading the newspaper report
Brainstorming characteristics of astronauts
Discussing profit motive and quality control
Writing letters requesting information

Application
Information gathering and analysis to future reading
Quality control to safety
The profit factor to risk taking

Impact
Career choices
Quality of workmanship

Interfacing with Other Disciplines

Language Arts: Students will read and analyze a newspaper article and draw conclusions.

Science: Students will understand the importance of orbits and the effect of the atmosphere on satellites.

Social Studies: Students will see a different work environment and understand the importance of quality workmanship in their own effort.

Critical Thinking Skills Reinforced

The students will make deductions about the profit motive, quality control, and qualifications of astronauts. Reading, studying, and discussing a newspaper article about a true space adventure will give students an idea of how to analyze information and draw deductions.

Teaching Tips

1. This activity is a good prerequisite for Module 15, "Current Developments in Space Technology." It will give the students an idea of how to analyze information and make deductions when they find their own articles.
2. Make a transparency of the article and the illustration sheet for discussion.
3. You may want to write to NASA, in advance, and provide the students with information on requirements and training for astronauts, rather than having them write and wait for the material.

Instructional Strategy

- Open the class by reading and studying the article and illustration.
- Monitor the students as they complete the worksheet, then encourage them to share their ideas during the brainstorming secession.
- Close the class by pointing out the profit motive and emphasize the responsibility of each worker towards his employee, his company and society.

Equipment/Supplies

Word-processing program or quality paper and a pen for writing a letter requesting astronaut training information.

Evaluation Key

Evaluate the worksheets according to workmanship (neatness and accuracy).

Modifications for Handicapped, Disadvantaged, and LEP Students

Some students may need additional time to complete the worksheet and someone to record their ideas.

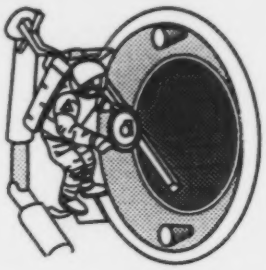
Name_____

"Got it!" Worksheet

1. Identify ten characteristics that you think a person would need to be a good astronaut.
   (1)_____
   (2)_____
   (3)_____
   (4)_____
   (5)_____
   (6)_____
   (7)_____
   (8)_____
   (9)_____
   (10)_____
2. Why do you think business and industry take on high risks and make huge investments to explore and develop outer space?
   _____
   _____
   _____
3. Why are high standards for quality control important in the space industry?
   _____
   _____
   _____
4. If there were no risk involved, why would good workmanship and high-quality control standards be important in other businesses?
   _____
   _____
   _____
   _____

"Got it!" Illustration Sheet—taken from an Associated Press article printed in the *Austin American-Statesman* on May 14, 1992.

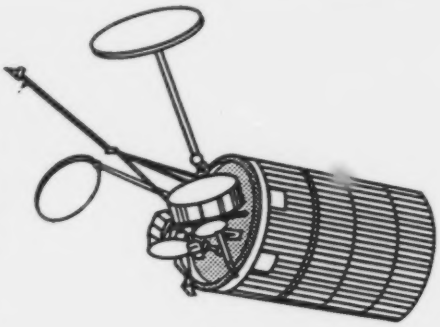
Space Shuttle Endeavour Mission
Failed Rescue



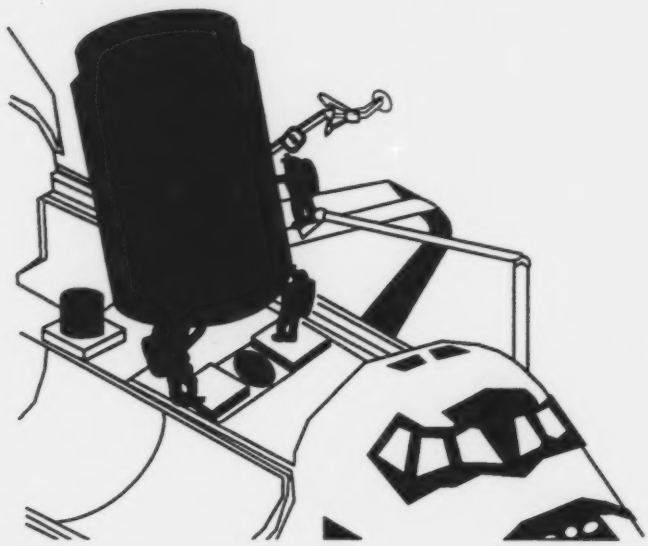
Astronauts had failed for two days to snare a marooned communications satellite with a 15-foot, spring-loaded capture bar designed to grab the satellite and stabilize it. They had been unable to attach the bar to the bottom of the satellite. The slightest push against the 17-by-12-foot cylinder caused it to wobble like an off-balance top.

Intelsat-6 Statistics

- Intelsat-6 is a 17-by-12-foot (when closed), 9,000-lb communications satellite built in 1982.
- It is designed to carry 120,000 telephone calls and three television broadcasts simultaneously.
- The outer surface is covered with solar cells that generate more than 2,600 watts.
- The satellite was financed by a consortium of 122 countries at a cost of $157 million.
- It is estimated that the satellite could generate at least $120,000 per day or $1 billion over its 12-year lifetime.



Successful Rescue



1 One astronaut stood attached to the cargo bay arm, while the other two were secured to a 15-foot work bridge spanning the width of the cargo bay.

2 On the command "Let's do it!" they grabbed the edge of the rotating satellite and stopped its motion.

3 Once the capture arm was attached, the cargo bay arm was connected and guided the satellite into the cargo bay.

4 In the cargo bay, the crew planned to lower the satellite onto a booster rocket, which would lift it from its current orbit of 225 miles to the intended orbit of 22,300 miles.

"GOT IT! SPACEWALKERS GRAB SATELLITE"

Draw conclusions about the qualifications and training an astronaut needs, understand the role of business and industry in space development, and realize the need for excessive quality control.

Challenge Statement
Due to a miswired booster rocket, a $157 million satellite was left in the wrong orbit and will burn up in the atmosphere. A faulty gasket in the fuel line caused the loss of seven lives in the Challenger explosion. Could proper inspections avoid disasters, saving lives and money?

In spite of high risks, space exploration and development continues at a fast pace. What is the motivation to participate in a high-risk, life-threatening occupation? What qualifications do people need to be astronauts? What training is required?

Objectives
- To understand the profit motive factor in commercial space exploration and development
- To outline probable qualifications for astronauts
- To research training requirements for astronauts
- To understand the need for quality workmanship and high standards of quality control

Vocabulary/Concepts Reinforced
- Challenger disaster
- Profit motive
- Commercial mission
- Federal subsidy
- Consortium

Equipment/Supplies
Word-processing program or quality paper and a pen for writing a letter requesting astronaut training information.

Introduction
The following excerpts are from an Associated Press article printed in the *Austin American-Statesman* on May 14, 1992.

> **"Got It! Spacewalkers Grab Satellite**
>
> CAPE CANAVERAL, Fla. Three astronauts ventured into the void of space Wednesday night, reached out with gloved hands and snared a 4 1/2-ton, slowly spinning satellite in a last ditch effort to save the craft.
>
> The astronauts held onto the Intelsat-6 satellite for 1 1/2 hours—one earth orbit—to steady it while they attached a bar that could be used as a handle for the shuttle's crane.
>
> The shuttle's seven-member crew had failed on two previous days to snare the satellite. But an emergency plan, executed by Pierre Thuot, Richard Hieb and Thomas Akers, worked.

The three stood in a triangular formation outside the shuttle. Thuot was on a platform held by the shuttle crane, Hieb was on a sill at the edge of the cargo bay, and Akers was on a pole straddling the bay. All three were anchored to their posts by foot restraints.

The 122-nation consortium, whose full name is the International Telecommunications Satellite Organization—paid NASA $93 million for the rescue.

Intelsat stood to lose it all—plus $1 billion in potential communications revenue from the satellite—if the rescue failed.

The Intelsat was supposed to be placed in a 22,300-mile high orbit in March 1990, but a miswired Titan rocket left it 22,000 miles too low.

Endeavour did not have enough fuel for a fourth rendezvous. If Wednesday's mission did not succeed, the $157 million satellite eventually would have burned up in the atmosphere.

While Intelsat paid NASA $93 million for the rescue mission, NASA calculates that the mission costs $363 million.

Space shuttles have previously salvaged five satellites during four flights, but this was the first such attempt since the Challenger disaster, and the space agency hoped it would restore confidence in the agency and in the shuttle's unique capabilities.

The spacewalking plan had not been rehearsed by the crew, but NASA insisted it was safe. Engineers for the space agency spent two days scrutinizing blueprints to make sure there were no sharp edges on the satellite that could puncture a spacesuit.

A small rip or tear in the vacuum of space could kill a spacewalker."

Procedure

1. Read the newspaper report carefully. Study the illustrations. Discuss it with your class.
2. Take 10 minutes to individually answer the questions on the worksheet. Record all the characteristics for astronauts on the board. How many characteristics did the class list?
3. Discuss the motivation for business to explore and develop outer space. How will future space settlements affect society?
4. Discuss the reason for high standards of quality control in business and industry. In industry, can one person's mistake affect many people?
5. Compose a letter to send to NASA requesting information on qualifications and training for astronauts.

Evaluation

You will be evaluated on your worksheet. How important is your workmanship (neatness and accuracy)?

CURRENT DEVELOPMENTS IN SPACE TECHNOLOGY

Essential Elements: 75.50(b): 7A, 7B; (g): 2F
TAAS Objectives: Language Arts: RC 1-6; WC 1 -4

Challenge Statement
The earth has been around for billions of years, yet people did not successfully fly until the Wright Brothers made their first flight at Kitty Hawk in 1903. It was in 1958 that a satellite was put into orbit. Today the space shuttle successfully exits and enters the earth's atmosphere. Technology has advanced quickly since that first flight.

What is happening this week in the space program? What are the new developments and expectations for the future? Your students can use this simple activity as an introduction to space-related activities.

Systems Model
Resources
Students as investigators and reporters
Instructor as moderator and evaluator
Newspapers and current magazines

Processes
Scanning and reading current event materials
Reporting current developments in space technology
Evaluating current space developments
Projecting current space developments

Application
Reading skills to current space developments
Reporting skills

Impact
Interest in space technology
Career interests

Interfacing with Other Disciplines
Language Arts: Students will read, summarize, and report on current events in space development.
Social Studies: The technology teacher may coordinate any space-related activities with the social studies teacher as they discuss future developments in society.

Critical Thinking Skills Reinforced
Students will research, summarize, and report new developments in space. They will listen to reports from other students and analyze, apply, and expand the information through discussion. From this foundation, students will project future space developments.

Teaching Tips

1. Module 14, "Got It! Spacewalkers Grab Satellite," is a good prerequisite activity for this assignment.
2. Assign this activity a week in advance so that students will have ample time to review and summarize articles. Remind the class about the assignment on a daily basis. Not all students will have easy access to current events materials. It would be helpful to assign this as extra credit, not penalizing those students who have limited resources.
3. You may only receive a few articles, so be prepared to fill in with your own. The school librarian can supply you with past and present articles about space developments, if given enough notice.
4. Emphasize technological developments, discuss the impact of the developments, and predict future trends.

Instructional Strategy

- Assign the extra credit work to the students.
- Monitor the class as the students give reports.
- Lead a discussion that is relevant to current information.
- Point out the fast pace of technology.

Equipment/Supplies

Current magazines and newspapers

Modifications for Handicapped, Disadvantaged, and LEP Students

No modifications are necessary as this assignment is for extra credit.

CURRENT DEVELOPMENTS IN SPACE TECHNOLOGY

Become aware of the latest developments in space technology, and make a brief report.

Challenge Statement

The earth has been around for billions of years, yet people did not successfully fly until the Wright Brothers made their first flight at Kitty Hawk in 1903. The United States put a satellite in orbit in 1958. Today the space shuttle successfully exits and enters the earth's orbit. Technology has advanced quickly since that first flight.

What is happening this week in the space program? What are the new developments and expectations for the future?

Objectives

- To know what is currently happening in the space program
- To develop an awareness of the fast pace of technological developments

Equipment/Supplies

- Current magazines and newspapers

Introduction

Newspapers and weekly magazines keep us current in all areas of our country and the world. With our satellite communication system, we can learn what happens around the world instantly.

Procedure

1. You will read newspapers and current magazines to determine what's new in the space program. Find an article about the space program, and write a summary. You will give a brief report to the class.
2. Listen to reports from your classmates. Discuss the information.
3. Turn in your article for extra credit.

Evaluation

You will receive extra credit for your article and presentation.

HOT AIR BALLOON

Essential Elements: 75.50(b): 1A, 2C, 4A, 4B, 5A, 5B, 6A, 6B, 6E, 8A, 8B
75.50(g): 1A-D, 1F, 1G, 1H

TAAS Objectives: Language Arts: RC 1-6; WC 1-7
Mathematics: C 1, 3, 4; O 1-4; PS 1-4

Activity Overview
Students work in small groups to design, fabricate, test, and fly a hot air balloon.

Challenge Statement
To provide students with a small group problem-solving activity in which they work with several technology systems.

Systems Model
Resources
Students as experimenters, designers, craftsmen, and engineers
Instructor as resource person and engineer
Appropriate tools, supplies, and equipment
Resource materials

Processes
Teamwork in designing a hot air balloon
Making a pattern for construction
Cutting, bonding, and shaping materials
Testing the prototype
Writing a technical, analytical paper

Application
Basic physical and design principles to space technology
Integration of several systems of technology to a hands-on experiment

Impact
Ability to work in a team
Understanding and appreciation of technology
Problem-solving ability

Interfacing with Other Disciplines
Mathematics: Students will add, subtract, multiply, divide, and work with fractions and percentages. They will measure using an engineer's scale. They will determine volume and area of the hot air balloon.

Science: Students will expand their understanding of thermal dynamics, basic physics, and characteristics of materials.

Language Arts: Students will write a technical report.

Social Studies: The instructor can relate the history of hot air balloons.

Critical Thinking Skills Reinforced
Students will use application, analysis, and synthesis in both the design and fabrication of the balloon. "Evaluation" concepts are used in the preparation and completion of the written technical paper.

Teaching Tips
1. Encourage craftsmanship in the fabrication of the balloon.
2. Review safety procedures for handling materials and equipment, especially the use of propane stoves. Make certain that all safety precautions are followed. Have a fire extinguisher nearby.
3. Make a working example of the balloon to help students understand the size and shape parameters.
4. Experiment with different types of envelope materials.
5. Have students write a short technical paper related to the activity. This report should include references to resources, processes, applications, and impact.

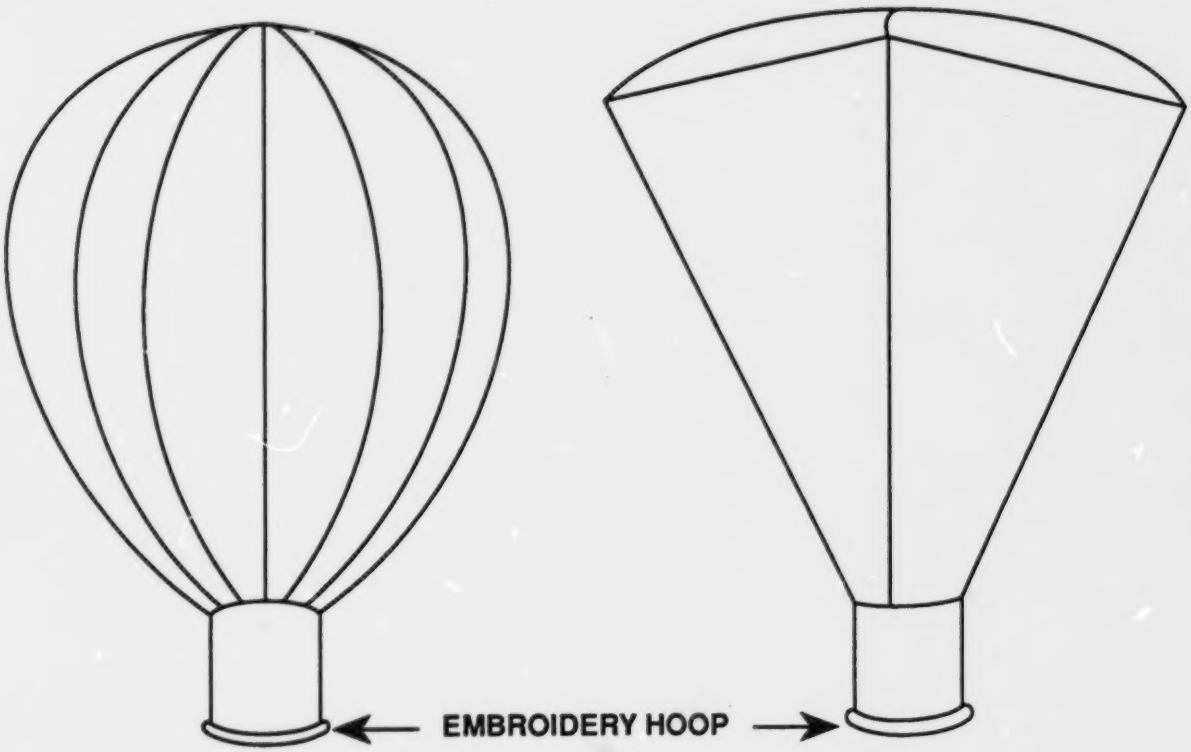
Instructional Strategy
- Use group discussion to present the activity to students.
- Use the demonstration method to help facilitate understanding.
- Use this activity as a small group team building project.
- Encourage the use of brainstorming to generate ideas.
- Use technical reference material as available.
- Have students complete a written technical paper related to the topic.

Equipment/Supplies
1. Tissue paper
2. Rubber cement
3. Embroidery hoop (4 1/2" hoop)
4. Scissors
5. Drawing paper and pencils
6. Scales
7. Propane burner
8. String

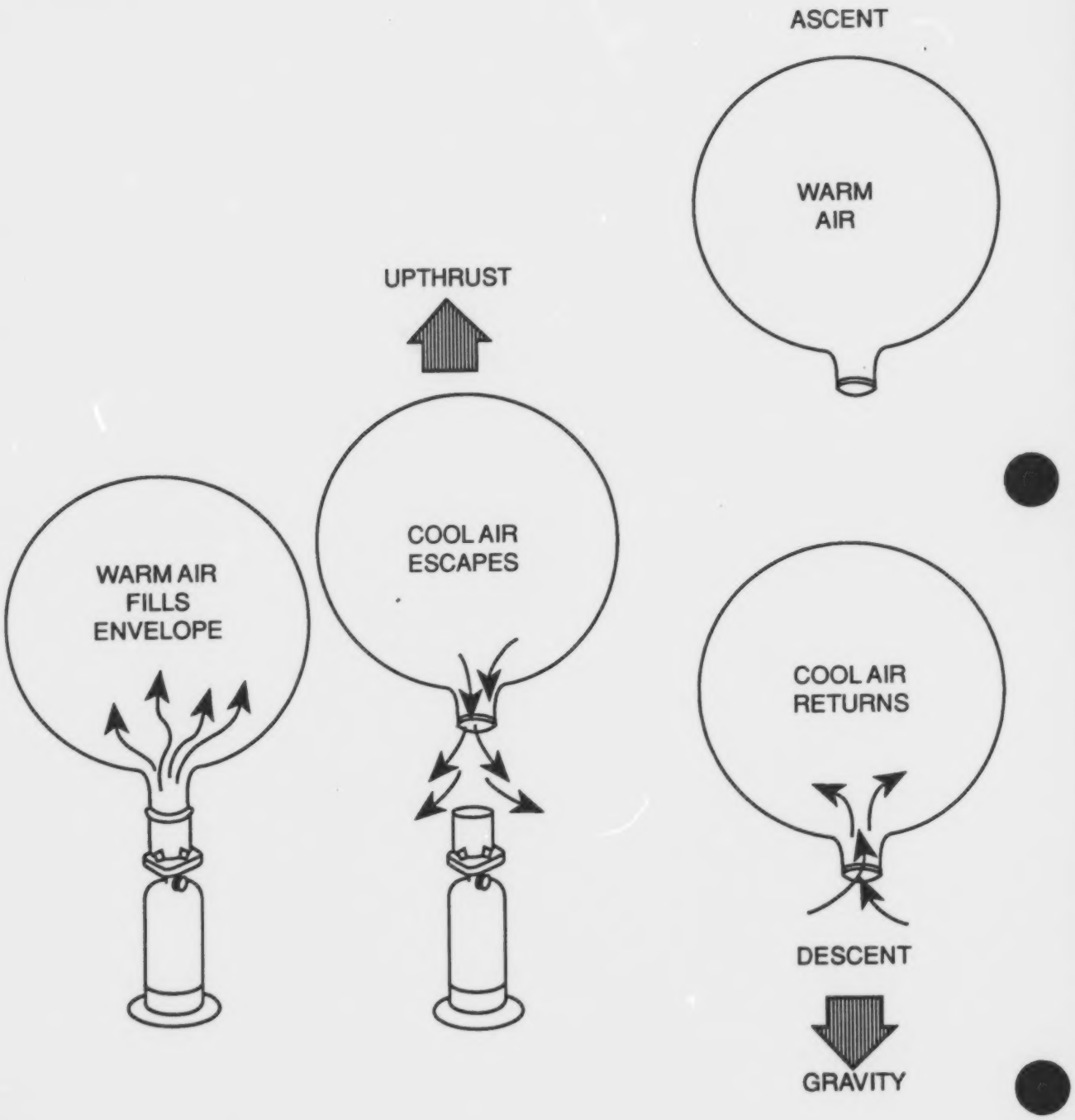
Evaluation Key
Evaluate students on the basis of their participation in and completion of the project, including completion of the written technical paper.

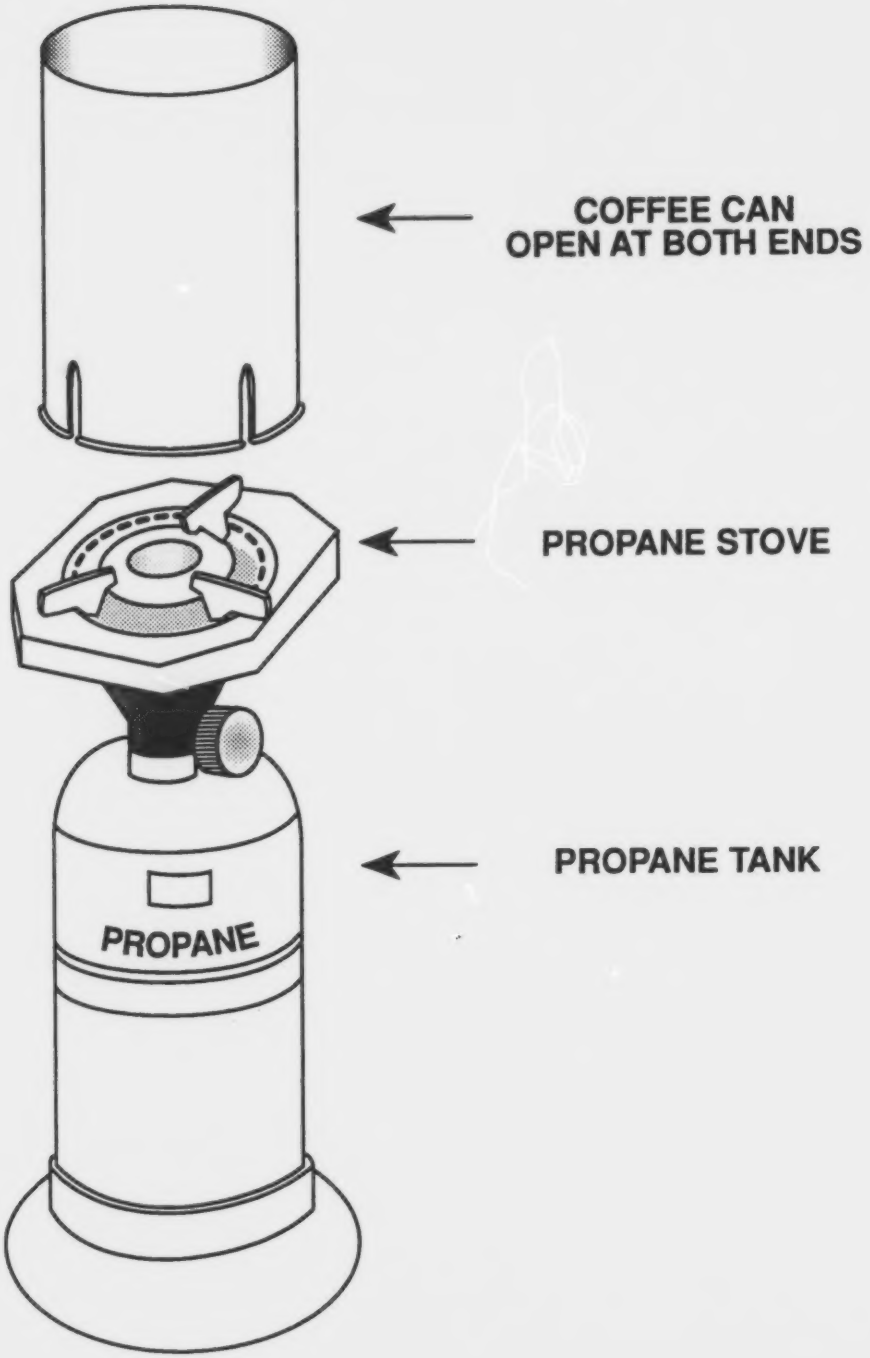
Modifications for Handicapped, Disadvantaged, and LEP Students
1. In general, become aware of the students with special needs in your classes. Seek as much background information as you can regarding learning styles for your special needs students. You will find that the suggested modifications will fit into your teaching style with very little effort.
2. Take advantage of helping teachers.
3. Use available special vocational funds to modify, build, or acquire "special" equipment or furniture that can be used.
4. Have special needs students placed in classes where appropriate. Determine whether it would help to have them in one class or spread throughout several classes.
5. Use the buddy system. Assign an advanced-level student to help the special needs students where appropriate.
6. Above all else, make the special needs student feel that he or she belongs.

EXAMPLES OF BALLOON SHAPES



HOT AIR BALLOON FLIGHT




COFFEE CAN
OPEN AT BOTH ENDS
PROPANE STOVE
PROPANE TANK
PROPANE

HOT AIR BALLOON

Work in small groups to design, fabricate, test, and fly a hot air balloon model.

Challenge Statement

To provide students with a small group problem-solving activity in which they are given an opportunity to work with several of the technological systems.

Objectives

- To work as a member of a group to complete a problem-solving activity
- To read and understand a set of design criteria for a simple hot air balloon
- To build and test a model based on given design criteria
- To prepare a basic written technical report

Vocabulary/Concepts Reinforced

- *Ascent*—to move upward. In a hot air balloon, ascent is achieved when the air inside the envelope is heated, making it lighter than the cool air around it.
- *Descent*—to move downward. As the warm air cools, the weight of the air inside the envelope returns to the weight of the outside air. The weight of the envelope and its payload causes the balloon to descend.
- *Envelope*—the ballon shape created by assembly of fabric panels.
- *Upthrust*—the force which helps the balloon lift. Upthrust in a hot air balloon is created when the air in the envelope is heated, causing some of the cooler air to be forced out of the envelope. The effect of this expansion creates lighter air inside the envelope, and as the weight decreases, the upthrust helps to float the balloon.

Equipment/Supplies

- Tissue paper
- Rubber cement
- Embroidery hoop (4 1/2" hoop)
- Scissors
- Drawing paper and pencils
- Scales
- Propane burner
- String

Introduction

This activity is intended to help students work successfully as team members to complete a technical problem-solving activity. Students will be divided into small groups and will be expected to work cooperatively to successfully complete the design, fabrication, testing, and flying of the hot air balloon.

Procedure

1. Divide into small groups of three or four students. Your instructor will help determine group membership as needed.
2. Your instructor will discuss the general requirements and expectations with the entire class. He or she will spend some time talking about teamwork and how it is used in industry to solve technical problems. He or she will also demonstrate how to create a basic ballon section pattern that can be used to

form the panels for the hot air balloon. The instructor will also demonstrate the launching and recovery steps.

3. Your instructor will cover any necessary safety precautions related to the handling of the propane burner and additional safety-related information as necessary.
4. After the instructor's demonstration has been completed, each group will meet to discuss how they will complete the project. The group should appoint one person to serve as group leader. This person will be the group contact person and will also be responsible for securing materials and equipment for the team.
5. The group leader should obtain a copy of the general design specifications and discuss them with the group. The specifications are general enough to allow for a great deal of design flexibility and creativity.
6. During this inital meeting, each group should outline the responsibilities for each member. Take advantage of member talents such as drawing skills, craftsmanship, creativity, etc.
7. Begin the design process. Drawing paper, computers, scales, pencils, etc., are available for your use. After completing your balloon design and logo design, present them to the instructor for approval.
8. Upon approval of your designs, you may begin fabrication of the balloon. Remember to be as neat as possible in the assembly of the panels. The tissue material is very fragile and will tear easily. Make sure that your seams are completely glued together.
9. Arrange for a test of the balloon with your instructor. Check to make sure that all of the seams are closed and the balloon will retain heat as long as possible. Remember, this is only a test. Do not launch your balloon until it has been certified by your instructor to fly.
10. Upon completion of the balloon and certification by the instructor, you may enter your balloon in the final flying competition. The launching schedule will be posted by your instructor. Your instructor may have established additional competition rules.
11. Upon completion of the flight, your group is responsible for completing a written technical paper in which you evaluate your success or failure on this particular activity. Your technical paper should be based on how the activity fits into the Universal Systems Model. The technical paper should address the following: RESOURCES, PROCESSES, APPLICATIONS, and IMPACT.

Evaluation

Evaluation of student performance on this activity will be based on participation in and completion of the project. Additional assessment will be based on completion of the written technical paper.

SPECIFICATIONS

Balloon—The basic balloon should be no more than 4 feet in height from the base of the balloon to the top. The balloon base should form around a 4 1/2" embroidery hoop or other such device as may be specified by your instructor. The ballon base should fit loosely over the top of the burner stack (as illustrated) to allow a smooth flow of hot air to fill and inflate the balloon. Where seams occur in the balloon, a minimum 1/2" overlap is necessary to ensure proper sealing.

Balloon Flight—The balloon should be able to fly freely as high and as far as possible. It is recommended that flights be conducted inside the school gymnasium where the ceiling is high and crosswind currents are not a factor. If you must

conduct your flights outside, try to conduct flights on a day when wind conditions are favorable.

Contest—Your instructor will probably want your class to have a contest to test the flight characteristics of the balloons. Criteria such as longest flight, highest altitude, farthest flight, etc., can be used to evaluate the various balloons. Additional contest rules can be established by the instructor.

EGG DROP

Essential Elements: 75.50(b): 1A, 2C, 4A, 4B, 5A, 5B, 6A, 6B, 8A, 8B
75.50(g): 1A-D, 1F, 1G

TAAS Objectives: Language Arts: RC 1-6
Mathematics: C 3-5; O 1-4

Activity Overview

Work in small groups to design, fabricate, and test a device to protect a raw egg from breaking when dropped from a height of 6 feet.

Challenge Statement

Problem solving and teamwork are two important elements related to the industrial technology curriculum. It is also important to include activities in which students have an opportunity to actually learn by doing. This activity combines teamwork, problem solving, and elements of creative thinking.

Systems Model

Resources
Students as experimenters and engineers
Appropriate tools and supplies to make an egg drop package
Video equipment to film testing

Processes
Designing a package
Constructing a package
Testing and evaluating packaging

Application
Creative thinking to problem solving
Basic physical and design principles to marketing and technology

Impact
Appreciation of technology
Industrial packaging

Interfacing with Other Disciplines

Language Arts: Students will follow directions from written instructions.
Mathematics: Students will use measurement in designing and constructing the package.
Science: Students will use knowledge of materials properties to design package.
Social Studies: Students will work cooperatively on the project.

Critical Thinking Skills Reinforced

Students use elements of application in applying the design loop to the planning and design of the activity. Analysis is used by students in both the designing and fabrication of the egg protector. Students use synthesis in both the design and fabrication of the egg protector. Evaluation concepts are used in the observation of testing and in a final discussion of the activity.

Teaching Tips

1. Encourage craftsmanship in the design and fabrication of the egg protector.
2. Review any related safety information that is appropriate for your students.
3. Demonstrate any processes to your students that you feel are important to the success of the activity.
4. Videotape the students as they test their devices. This information can be used in the final analysis of the activity and to show to other students as appropriate.
5. The instructor should write the specifications on the board for all students to study.

Instructional Strategy

- Use a group discussion to present the activity to students.
- Use the demonstration method to help facilitate understanding.
- Use this activity as a small group team building project.
- Encourage the use of brainstorming to help generate ideas.
- Use technical reference material regarding packaging desing that might be appropriate.
- Have students participate in a follow-up discussion at the completion of the activity.

Equipment/Supplies

1. Typing paper
2. Masking tape
3. 6-foot ladder
4. Raw eggs
5. Plastic dropcloth material
6. Video camera and tape

Evaluation Key

Students will automatically receive an "A" if their egg does not crack. Students with cracked or broken eggs may revise their packaging for an "A."

Modifications for Handicapped, Disadvantaged, and LEP Students

This activity can be easily modified to meet the needs of special students. Teaming special needs students with non-special-needs students is one method of ensuring that they can participate fully in this activity.

EGG DROP

Work in small groups to design, fabricate, and test a device to protect a raw egg from breaking when dropped from a height of 6 feet.

Challenge Statement
To provide student with a small group problem solving activity in which they are given an opportunity to design, construct, and test a device based on a set of design criteria.

Objectives
- To work as a member of a group to complete a problem-solving activity
- To read and understand a set of design specifications
- To participate as a responsible team member in designing, fabricating, and testing a device of the team

Vocabulary/Concepts Reinforced
- *Specifications*—a set of written criteria established to identify the precise function and materials that are to construct an object. In some cases, specifications are used to identify exact design requirements.

Equipment/Supplies
- Typing paper
- Masking tape
- 6-foot ladder
- Raw eggs
- Plastic dropcloth material
- Video camera and tape

Introduction
This activity is intended to help students work successfully as team members to complete a technical problem-solving activity. Students will be divided into small groups of two or three students and be expected to work cooperatively to successfully complete the design, fabrication, and testing of a device to protect a raw egg when dropped from a height of 6 feet.

Procedure
1. The first step in the activity is to divide the class into groups of two or three students.
2. Each group is to study the following specifications:
   Specifications: A device is to be designed and constructed that will serve to protect a raw egg from a drop release of 6 feet. The only materials that can be used to construct the device are two sheets of 8 1/2" by 11" typing paper and no more than 36 inches of 3/4 inch masking tape. No other materials can be used in constructing the device. The device is to be designed such that it will completely contain a raw egg from the time it is dropped until contact with the ground.
3. After careful study of the specifications, each group is to begin their design phase of the activity. Groups should be encouraged to brainstorm ideas and create several sketches that they feel will work.

4. The instructor will cover any necessary safety precautions.
5. After your group has developed an idea, they will need to secure the necessary materials from the instructor to build a prototype. If their initial design fails to protect the egg, each group should carefully study the failed device for redesign considerations.
6. It may take several attempts to finally devise a successful device that will protect the raw egg. Don't be discouraged, keep trying.
7. When you have a device that will work successfully, your instructor will ask your group to demonstrate it to the class.
8. After each group has demonstrated its designs, your instructor will ask that each group participate in a general discussion of the activity.

DETERMINING CONSTRUCTION NEEDS

Essential Elements: 75.50(b): 1A, 2C, 2D, 3A, 6C, 6D, 8A
75.50(f): 1, 2, 5, 13, 17
75.50(g): 1A

TAAS Objectives: Language Arts: RC 1-6; WC 7
Mathematics: C 1, 5; O 1; PS 1-4

Activity Overview

Your students will design and conduct a survey to determine the need for a service in your area, then they will analyze the information from the survey to develop a list of construction priorities. From that information, they will draw a rough sketch of a facility that would meet the needs of the business or organization that provides the greatest service to the community.

Challenge Statement

When towns, cities, or suburbs start to grow, the volume of services necessary to meet the needs of the residents increases. Schools, churches, medical facilities, businesses, and recreational facilities are only a part of the makeup of a community. Proper planning is beneficial in determining the needs of a community and designing attractive buildings.

Without proper planning, many buildings could be built and not used. Most towns have relatively new buildings that are empty because of a lack of planning. Business people cannot afford to waste time and money by supplying goods and services people do not need or want. **Surveys** help to eliminate the problem by determining the needs and wants of a large number of people. This helps investors make decisions about how they will invest their money. Once a need is identified, planning begins to determine the best way to meet the need.

Often a structure must be built or remodeled to house the organization or business that provides the service. For instance, you could not run a hospital from a restaurant or a health club out of a nursery school. Buildings must be designed and built to meet the needs of the people or the service.

Systems Model

Resources
Students as city planners, architects, and builders
Teacher as facilitator
Newspapers for current events
Needs survey
Sketching materials

Processes
Evaluating current events
Community observations
Brainstorming and designing survey
Surveying community needs
Analyzing and reporting survey results
Designing facility

Application
City planning
Mathematical surveying and analysis
Building design

Impact
Social services
Financial investments
City planning
Architecture

Interfacing with Other Disciplines

Mathematics: Students will design, conduct, analyze, and record the results of a survey.

Language Arts: Students will identify new ideas, analyze written information, and project outcomes through written surveys.

Social Studies: Students will study the needs of their community and propose ways to meet their needs. They will come to an understanding of how to use the resources of the community to meet the needs of the individual.

Critical Thinking Skills Reinforced

Through the brainstorming and surveying process, students will analyze and synthesize information, draw conclusions, adapt the need of a community to a facility, and report solutions through the sketching process.

Teaching Tips

1. Gather newspapers or magazines that have information about construction planning in your area or at large. This could include articles about mass transit systems, manufacturing facilities, and state or local buildings. Discuss how each of these enterprises will meet a need. Discuss the reasons buildings in your area may be empty. For instance, in large towns, buildings were in use during the strong economy, but were left empty when businesses failed during the downswing. In small towns, when Wal-Mart moves into town, many of the small local businesses fail, and the buildings are vacated. Discuss the impact on employment, banking, investing, individuals, and the community when construction is useless due to poor planning or total lack of planning. Now talk about the purpose of needs surveys.
2. Help the students design a survey to determine the need for services in your community. Relate the needs to providing buildings to house the business or organization that meets the needs.
3. Each student should survey at least five people of different age groups. They will find that different age groups will perceive their needs differently. Distinguish between needs and wants.
4. Help the students compile the information from the surveys. You may want to divide them into groups of four or five, then come together as a class for the final tally. It would be most helpful to chart the results. Some students may want to chart the information as a group, or work overnight for extra credit. Prioritize the needs.
5. Choose the greatest need, and brainstorm the type of organization that would be necessary to fill it. Brainstorm the type of structure that would be necessary to house them. Be sure students take notes during this time.
6. Have each student draw a sketch of the structure as they see it.
7. Review the sketches. Point out the strongest ideas, and incorporate them into one. If you choose to spend the time, you could sketch a master plan on the board that incorporates all the strong points into one plan. Point out that different people have different ideas and that is where competition comes in in a free enterprise system. The more people like your ideas and your work, the more business you get!

8. Help the class think of empty buildings in your area that could be remodeled to accommodate the organization. Discuss the advantages in recycling space.

Instructional Strategy

- As a facilitator, introduce the concept of survey taking through the discussion of current events and observations of your community. Through discussion, students will understand the importance of adequate planning, with the determination of needs as the first step.
- You will use brainstorming in both designing the survey and designing the structure. Review both to emphasize the advantages and eliminate weaknesses.
- In closing, emphasize the relationship between needs, design, and outcome and the impact of proper planning on the investors, architects, builders, service workers, and the community. Point out that planning is an essential part of any endeavor as it helps to avoid long-term problems.

Equipment/Supplies

1. Newspaper articles
2. Materials for sketching

Evaluation Key

Evaluate students on how well they participate in the class discussions, on the number of people surveyed, and on their sketches.

Support Materials

1. Harms, H.R., and Kroon, D.K. *Production Systems Technology*. Peoria, Ill: Glencoe, 1992.
2. Ritz, J.M.; Hadley, W.F.; and Bonebrake, J. *Exploring Production Systems*. Albany, N.Y.: Delmar, 1990.

Sample Survey

Age category (circle one)
12 -20 21 -30 31-45 46 - 65 66+

Major Interests
☐ Sports
☐ Reading
☐ Outdoor activities
☐ Crafts
☐ Education
☐ Shopping
☐ Movies

ZIP Code_____

Services you feel are lacking in your area (check one)
☐ Health care
☐ Reputable child care
☐ Extended education
☐ Athletic—for children
☐ Athletic—for adults
☐ Library
☐ Entertainment

Sample Survey

Age category (circle one)
12-20 21-30 31-45 46-65 66+

Major Interests
☐ Sports
☐ Reading
☐ Outdoor activities
☐ Crafts
☐ Education
☐ Shopping
☐ Movies

ZIP Code_____

Services you feel are lacking in your area (check one)
☐ Health care
☐ Reputable childcare
☐ Extended education
☐ Athletic—for children
☐ Athletic—for adults
☐ Library
☐ Entertainment

DETERMINING CONSTRUCTION NEEDS

Design and conduct a survey to determine the need for a service in your area, then analyze the information to develop a list of construction priorities. From that information, draw a rough sketch of a facility that would meet the needs of the business or organization that provides the greatest needed service to the community.

Challenge Statement

When towns, cities, or suburbs start to grow, the volume of services necessary to meet the needs of the residents increases. Schools, churches, medical facilities, businesses, and recreational facilities are only a part of the makeup of a community. Proper planning is beneficial in determining the needs of a community and designing attractive buildings.

Without proper planning, many buildings could be built and not used. Most towns have relatively new buildings that are empty because of a lack of planning. Business people cannot afford to waste time and money by supplying goods and services people do not need or want. Surveys help to eliminate the problem by determining the needs and wants of a large number of people. This helps investors make decision about how they will invest their money. Once a need is identified, planning begins to determine the best way to meet the need.

Often a structure must be built or remodeled to house the organization or business that provides the service. For instance, you could not run a hospital from a restaurant or a health club from a nursery school. Buildings must be designed and built to meet the needs of the people or service.

Objectives

- To understand reasons for conducting a construction needs survey
- To know the basic purposes of structures
- To recognize how surveys are used to choose and design a construction project

Vocabulary/Concepts Reinforced

- Architecture
- City planners
- Facility
- Goods
- Investors
- Needs
- Services
- Survey
- Wants

Equipment/Supplies

- Newspaper articles
- Construction Survey Form
- Construction Priority Chart
- Materials for sketching

Introduction

You may have noticed empty buildings in your ares. Some of these may have been built and never used or used for only a short time. This is the result of a lack of proper planning or of no planning at all. Someone is losing a lot of money from those empty buildings. As an architect or builder, you could lose money if the investors cannot afford to pay you for your work. That is why planning is important to you.

In this activity, you will act as a city planner by designing, conducting, and analyzing a survey to determine the needs of the people in your community. Once you have determined the need, you take the role of the architect and draw a sketch of a structure that would house the business or organization that would meet the need for the community.

Procedure

1. Participate in a discussion led by your teacher about planning and/or lack of planning for buildings in your community.
2. With your class, brainstorm and design a survey to conduct in your area about services that would benefit your community.
3. Conduct the survey.
4. Compile and analyze the surveys from the entire class, and prioritize the needs of the community.
5. Take the number one need and brainstorm the type of structure that would be necessary to accommodate the business or organization that would meet the need for the community. Take notes to refer to when you begin your design process.
6. Draw a sketch of the building. You may be able to identify an empty building in the community that could easily be remodeled to suit your purposes. This would save money, and time, and make use of wasted space!
7. Review the sketches for design and practicality.

Evaluation

You will be evaluated on how well you participate in the class discussions, on the number of people you survey, and on the sketch you design.

ESTIMATING BUILDING MATERIALS

Essential Elements: 75.50(b): 2C, 2D, 5A, 5B, 6A, 6B, 6E, 7B
75.50(g): 1B, 1F, 1H, 2D

TAAS Objectives: Language Arts: RC 1, 2, 4, 5; WC 2-6
Mathematics: C 1-4; O 1-4; PS 1-4

Activity Overview

Students will study blueprints to determine estimates for building materials both manually and by computer. The students will compare the amount of time and the degree of accuracy of each method.

Challenge Statement

Builders and contractors must estimate building materials accurately in order to pass on the cost to their clients. Even small mistakes can lose the company money that cannot be made up after the bids are presented. Builders and contractors who make mistakes could lose their jobs or even their businesses.

Many builders do not have computers available, and they estimate costs by hand. Knowledge of computers and proper input save both time and money when making estimates.

Systems Model

Resources
Students as builders and contractors
Teacher as facilitator
Computers
Blueprints
Scales

Processes
Mathematic calculations
Computer input
Discussion of benefits and impacts
Written evaluation

Application
Residential and commercial construction
Manufacturing estimates
Career skills and responsibilities

Impact
Housing industry

Interfacing with Other Disciplines

Mathematics: Students will add, subtract, divide, multiply, and work with fractions and decimals. They will work with a standard ruler and an architect's scale.

Social Studies: Students will understand the importance of competent job skills in the marketplace.

Language Arts: Students will compare two methods of estimating bids and compose a paragraph giving the advantages of each.

Critical Thinking Skills Reinforced

Students will find the solution to a given problem through gathering information from blueprints, analyzing information, and applying appropriate processes. From the solution, students will draw conclusions about the advantages of each process and report the conclusions to the class.

Teaching Tips

1. Organize the class into groups of four.
2. Give each group a blueprint of a simple one- or two-room structure. The students will study the blueprint to determine the dimensions of the structure they are bidding and fill in the Estimating Materials form for each area.
3. Have each of the students in the group calculate the materials for the walls manually in order to learn the process. After they have completed the calculations, have them compare their results. If there are any discrepancies, help them determine their errors and correct them.
4. As a group, have the students enter the information into the computer. This will allow them to check their work and learn the computer program.
5. Each group will now work in twos. Two students will determine the materials for the flooring manually, and two will work on the computer. Then the groups will reverse and determine the materials using the other method.
6. With the completion of the calculations, the students will fill out their materials list and compare the results.
7. Each student will complete the evaluation sheet.
8. The students will turn in their materials sheets and their individual evaluation sheets.
9. Facilitate a discussion on the advantages and disadvantages of manual and computer calculations for the bidding process, and the impact of computers on the construction industry.
10. Observe the degree of participation of each student in the group. You may want to give the students additional problems to work individually to check for understanding.
11. Check the Estimating Materials forms and the evaluation sheets.

Instructional Strategy

- The students will need, as a *prerequisite*, knowledge of wall, floor, and roof structures.
- Have six or eight plans for a one- or two-room simple structure using different size window and door openings and different roof structures. It would help you to have done the computer calculations in advance.
- Use peer teaching in the use of the different computer programs.
- Use the discussion method to evaluate and compare the two bidding methods, stressing the need for accuracy. Discuss the impact of computers on the construction industry from the design process to prefabrication and assembly.

Equipment/Supplies

1. Computer, CRT
2. Estimating Flooring Materials program
3. Estimating Wall Materials program
4. Estimating Roofing Materials program
5. Printer
6. Architect's scale

Support Materials:

- Provide students with blueprints to create their own materials list and estimation problems.
- Estimating Materials form
- Cost of Materials sheet

- Evaluation sheet
- Provide your students with one or more sample problems that contain:

For walls:

a. length of the wall sections
b. length of the lumber
c. number of corners
d. number of intersections
e. number and size of openings
f. height of the wall
g. length and height of standard sheathing material

For roofing:

h. length of the top plate
i. spacing between joists
j. length of the rise
k. length of the run
l. length of the ridge

For flooring:

m. length of footing to be covered by the seal
n. length of joist header
o. length of construction lumber to be used
p. length of floor to be supported
q. spacing between joists
r. length of floor
s. width of floor
t. length and width of standard sheet material

Evaluation Key

Answers will vary somewhat.

1 - 2. Ability to do on-site bids; no need for a costly investment; meets small business needs
3 - 4. Time consuming; greater possibility for error
5 - 6. Saves time; more accurate; professional appearance
7 - 8. Costly; cannot give on-site bids; need training to master
9 - 10. Answers will vary.

Modifications for Handicapped, Disadvantaged, and LEP Students

Through the group method, students with disabilities will need no extra assistance.

Name_____

Estimating Materials

WALLS—Framing only

Blueprint #_____

Length of walls 1)_____ 2)_____ 3)_____ 4)_____
Type of material used_____Cost per unit_____
Type of material used_____Cost per unit_____

Types of openings 1)_____ 2)_____
Size of openings 1)_____ 2)_____
3)_____ 4)_____ 5)_____
Total wall dimension_____(—) Total openings_____
Type of material used_____Cost per unit$_____
Amount of materials needed_____
Complete calculations here.

Additional supplies (nails, etc.)_____
Cost per unit $_____ Cost per unit $_____

Total lumber $_____
Total supplies $_____

•**Total cost of walls** $_____

Name_____
Blueprint #_____

Flooring—Does not include pilings

Length of footing to be covered by the sill_____
Length of joist header_____
Length of construction lumber to be used_____
Length of floor to be supported_____
Spacing between joist_____
Dimensions of floor_____ Total area (sq. ft.)_____

Computing Solutions
Number of sillplate to be ordered_____ X Cost per unit $_____ = Total $_____
Number of joist headers to be ordered_____ X Cost per unit $_____ = Total $_____
Number of floor joist required_____ X Cost per unit $_____ = Total $_____
Number of standard sheet material _____ X Cost per unit $_____ = Total $_____
Supplies needed_____+_____+_____ Total $_____

- **Total cost of flooring** $_____

Roofing

Length of top plate_____ Type of materials needed_____
Spacing between joist_____ Length of rise_____
Length of run_____ Length of ridge_____
Length of rafters_____
Area of sheathing required_____ Number of sheets_____

Computing Solutions
Number of ceiling joist required_____ x Cost per unit $_____ = Total $_____
Number of rafters required_____ x Cost per unit $_____ = Total $_____
Number of sheathing required_____ x Cost per unit $_____ = Total $_____
Supplies needed_____+_____+_____ Total $_____

Total cost of flooring Total $_____

Name_____

Bidding Building Materials Evaluation Sheet

Write the answer to each item neatly. Each correct answer is worth 10 points.

List two advantages of calculating bids manually.

1. _____
2. _____

List two disadvantages.

3. _____
4. _____

List two advantages of calculating bids using a computer.

5. _____
6. _____

List two disadvantages of using the computer.

7. _____
8. _____

9. Write a statement about which you would prefer to use—manual bidding or computer bidding—and why.

_____
_____
_____
_____
_____

10. Write a short paragraph on the impact of computers on society through the construction industry.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

ESTIMATING BUILDING MATERIALS

Study blueprints to determine estimates for building materials both manually and by computer, and compare the amount of time and degree of accuracy for each method.

Challenge Statement

Builders and contractors must estimate building materials accurately in order to pass on the cost to their clients. Even small mistakes can lose the company money that cannot be made up after the bids are presented. Builders and contractors could lose their jobs and even their businesses to costly mistakes.

Many builders do not have computers available and estimate costs by hand. Knowledge of computers and proper input save both time and money when making estimates.

Objectives

- To encourage students and teachers to use the computer
- To solve the estimating problems accurately
- To show how the solutions are reached
- To develop career skills awareness

Vocabulary/Concepts Reinforced

- Bid
- Construction lumber
- Header
- Intersections
- Joist
- Ridge
- Rise
- Run
- Standard sheathing material
- Top plate

Equipment/Supplies

- Computer, CRT
- Estimating Flooring Materials Program
- Estimating Wall Materials program
- Estimating Roofing Materials program
- Printer
- Architect's scale
- Blueprints to create your own materials list and estimation problems
- Estimating Materials form
- Cost of Materials sheet
- Evaluation sheet
- Sample problems that contain:

For walls:

a. length of the wall sections
b. length of the lumber
c. number of corners
d. number of intersections
e. number and size of openings
f. height of the wall
g. length and height of standard sheathing material

For roofing:

h. length of the top plate
i. spacing between joists
j. length of the rise

k. length of the run
l. length of the ridge

For flooring:

m. length of footing to be covered by the seal
n. length of joist header
o. length of construction lumber to be used
p. length of floor to be supported
q. spacing between joists
r. length of floor
s. width of floor
t. length and width of standard sheet material

Introduction

This activity is designed to help you determine the cost of building materials and understand the importance of accuracy. You will see the savings in both time and accuracy through the use of computers.

Procedure

1. The teacher will organize the class into groups of four.
2. Get a blueprint of a simple one- or two-room structure from your teacher. Study the blueprint to determine the dimensions of the structure you are bidding. Fill in the Estimating Materials form for each area.
3. Each of you will calculate the materials for the walls manually in order to learn the process. After you have completed the calculations, compare your results. If there are any discrepancies, determine the errors and correct them.
4. As a group, enter the information into the computer. This will allow you to check your work and learn the computer program.
5. Each group will now work in twos. Two students will determine the materials for the flooring manually, and two will work on the computer. Then the groups will reverse and determine the materials by the other methods.
6. With the completion of the calculations, fill out the materials list and compare the results.
7. *Each* of you will complete the evaluation sheet individually.
8. Turn in your materials sheets and individual evaluation sheets.
9. Participate in a discussion of the advantages and disadvantages of manual and computer calculations for the bidding process, and the impact of computers on the construction industry.

Evaluation

You will be graded on how well you participate in and cooperate with your group.
You will be expected to work on all the calculations during the class period.
The materials list and the evaluation sheet will be graded for accuracy and neatness.

UNDERSTANDING FOUNDATIONS

Essential Elements: 75.50(g): 1F, 2C, 2D
TAAS Objectives: Language Arts: RC 1, 2, 4, 5; WC 2, 6
Mathematics: C 1, 3, 4; PS 2

Activity Overview

This activity is designed to help the students understand the need for a proper foundation in construction. They will have an opportunity to work with materials that will show how problems can arise from a poor foundation, and they will learn proper construction methods to correct them.

Challenge Statement

If a foundation is not built properly, it can crack and cause serious damage to the building which is very costly and difficult to repair. It is better to do the job right the first time!

When you are standing, the weight of your body is supported by your feet and the ground under you. Your feet and the ground provide a foundation so that you can stand. A building foundation must support the entire structure, including walls, roof, appliances, furniture, and other fixtures.

Systems Model

Resources
Students as experimenters
Instructor as facilitator
Tools, materials, and supplies

Processes
Organization of materials
Materials manipulation and experimentation
Observation and analysis of results
Application of findings

Application
Construction industry
Physical science

Impact
Safe buildings for society
Occupational responsibilities

Interfacing with Other Disciplines

Mathematics: Students will participate in activities that require measuring and chart reading.
Science: Students will observe the properties of different materials and draw conclusions.

Critical Thinking Skills Reinforced
Through observation and information gathering, students will understand the importance of proper foundations and draw conclusions about how to adapt different types of foundations to different types of soil.

Teaching Tips
1. Gather all the materials for the student activity.
2. Divide the class into groups to complete the activity. If supplies are limited, the activity can be given as a demonstration.
3. Make a transparency of the "Bearing Capacity Average Safe Load of Soil" chart. Explain the different types of soils and foundation requirements.
4. Through discussion, check for understanding.
5. Have the students complete the evaluation sheet.

Instructional Strategy
- Explain the activity thoroughly to the students.
- Facilitate the activity.
- Explain the "Bearing Capacity Average Safe Load of Soil" chart, and emphasize the importance of responsibility in building.
- Discuss the different types of foundations and their uses, and check for understanding.
- Discuss and grade the evaluation sheet.

Equipment/Supplies
1. 1 claw hammer
2. 1 large sponge
3. 4 common nails (8d)
4. 1 foundation wall
5. 1 raft footing
6. 4 pieces wood (3/4" x 1" x 4")
7. 1 piece wood (3/4" x 6" x 12")
8. 1 board (3/4" x 6" x 12")
9. 1 brick
10. 1 plastic box or dishpan with sand
11. 1 spread footing
12. 1 piece sheet metal (2" x 16")
13. 1 piece plywood (3/8" x 5" x 5")

Evaluation Key
1. Foundation—the part of a building which supports a superstructure.
2. Footing—a masonry section, usually concrete, in a rectangular form wider than the bottom of the foundation wall or pier it supports.
3. Piles—long posts driven into the soil in locations where it is difficult to secure a firm foundation.
4. Slab—a strip of concrete poured as a large unjointed piece used as the foundation of a building.
5. Bearing surface—an area used to support a structure.
6. (1) bearing surface
   (2) footing
   (3) upright support
7. by determining the frost line for the area
8. The walls and ceiling would crack. The doors and windows would not operate properly. Windows could break.
9. Repair it free of charge.
10. Repair it free of charge.

Understanding Foundations
Evaluation Sheet

Define the following terms: (Neatness counts.)

1. Foundation

2. Footing

3. Piles

4. Slab

5. Bearing surface

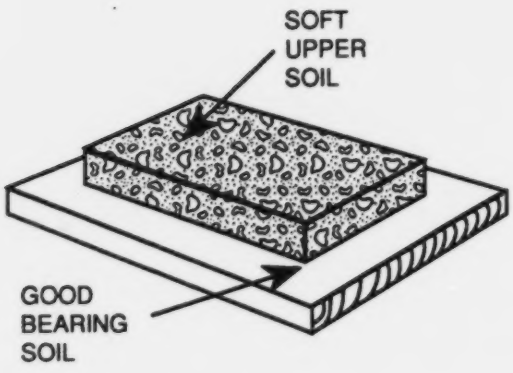
6. Name the three basic parts of a foundation.
(1)_____(2)_____(3)_____

7. How do you determine the depth of the foundation?
_____
_____

8. What happens to a structure built on a poor foundation?
_____
_____
_____
_____

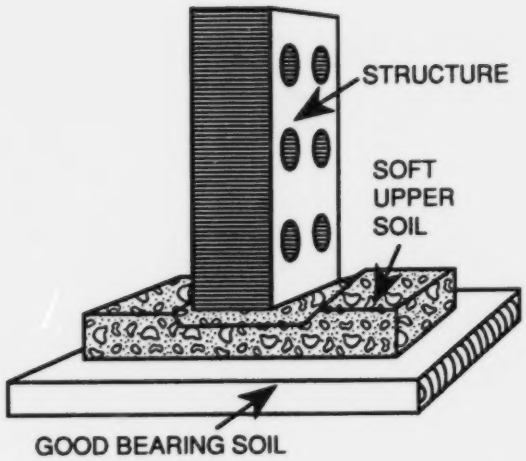
9. If you buy a home from a contractor and the foundation cracks, what would you expect him to do?
_____
_____
_____
_____

10. If you are a contractor and the slab cracks in a structure you built, what would you do?
_____
_____
_____
_____



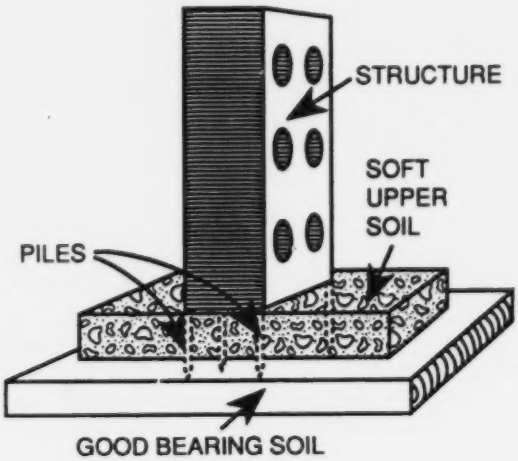
Simulated Soil Test

Fig. 1



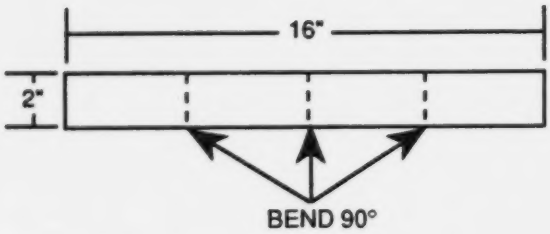
Simulated Foundation Wall

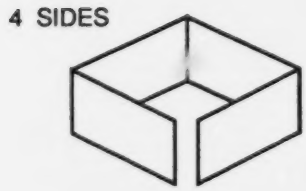
Fig. 2



Pile Cap Foundation

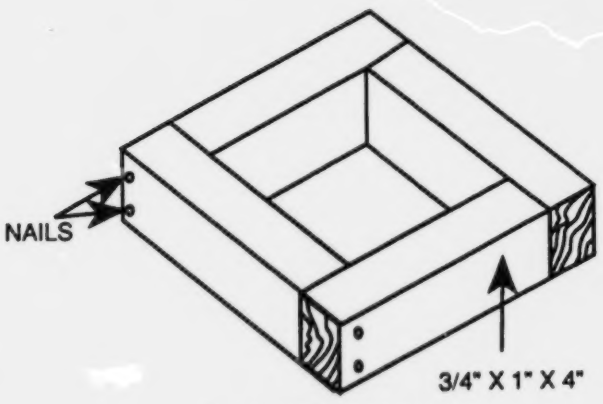
Fig. 3





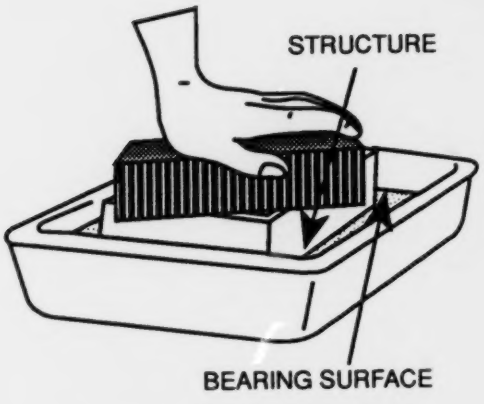
Simulated Foundation Wall

Fig. 4



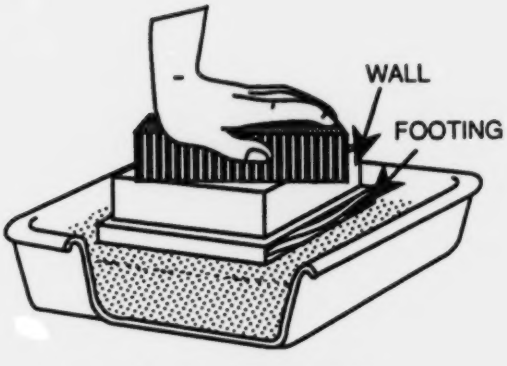
Simulated Spread Footing

Fig. 5



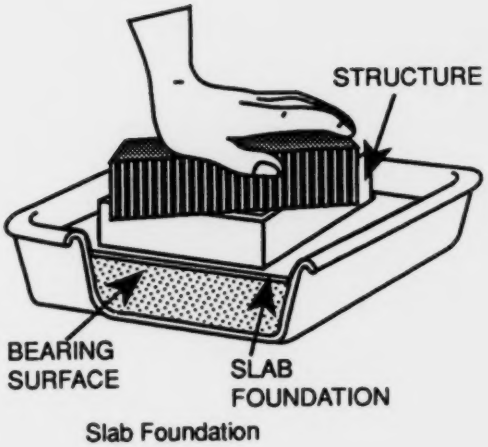
Structure without a Foundation

Fig. 6



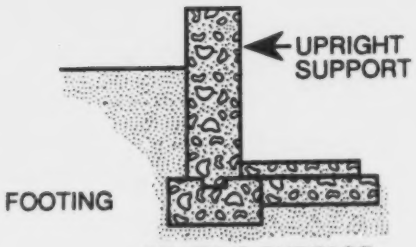
Spreading Footing Foundation

Fig. 7

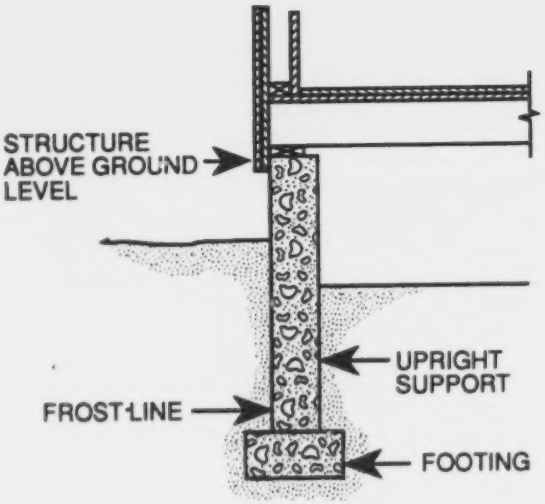


Slab Foundation

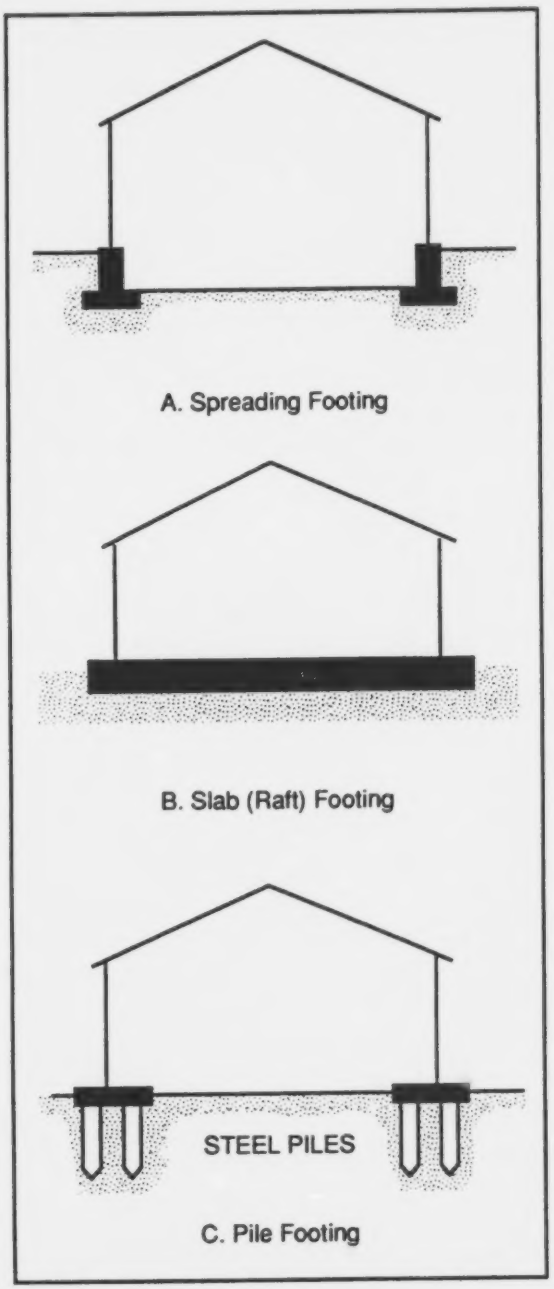
Fig. 8



A foundation has three basic parts.



Foundations must extend below the frost line. Otherwise, freezing weather may cause damage to the structure.



Types of Footings

Bearing Capacitly Average Safe Load of Soils

Soil Type	U.S. Customary	
	U.S. Tons PSF[1]	U.S. Pounds PSF[1]
Soft clay; sandy loam	1	2,000
Firm clay; sand and clay mix; fine sand loose	2	4,000
Hard dry slay; fine sand, compact; sand and gravel mixtures; coarse sand, loose	3	6,000
Coarse sand, compact; stiff clay; gravel,loose	4	8,000
Gravel; sand and gravel mixtures, compact	6	12,000
Soft rock	8	16,000
Exceptionally compacted gravels and sands	10	20,000
Hardpan or hard shale; sillstones; sandstones	15	30,000
Medium hard rock	25	50,000
Hard, sound rock	40	80,000
Bedrocks, such as granite,gneiss, taprock	100	200,000

[1]Safe load per square foot

UNDERSTANDING FOUNDATIONS

Understand the need for a proper foundation by working with materials that show how problems can arise from a poor foundation.

Challenge Statement

If a foundation is not built properly, it can crack and cause serious damage to the building which is very costly and difficult to repair. It is better to do the job right the first time!

When you are standing, the weight of your body is supported by your feet and the ground under you. Your feet and the ground provide a foundation so that you can stand. A foundation must support the entire structure, including walls, the roof, appliances, furniture, and other fixtures.

Objectives

- To understand the conditions under which soil will settle
- To determine the effect of water content upon settling
- To demonstrate knowledge of footings and foundations
- To stress the importance of doing a job well for long term benefit

Vocabulary/Concepts Reinforced

- Bearing surface
- Claw hammer
- Footings
- Foundation
- Piles
- Slab
- Slab footings
- Spread footings

Equipment/Supplies

- 1 claw hammer
- 1 large sponge
- 4 common nails (8d)
- 1 foundation wall
- 1 raft footing
- 4 pieces wood (3/4" x 1" x 4")
- 1 piece wood (3/4" x 6" x 12")
- 1 board (3/4" x 6" x 12")
- 1 brick
- 1 plastic box or dishpan with sand
- 1 spread footing
- 1 piece sheet metal (2" x 16")
- 1 piece plywood (3/8" x 5" x 5")

Introduction

This activity is designed to help you understand the need for a proper foundation. You will have an opportunity to work with materials that will demonstrate how problems can arise from a poor foundation, and you will learn how to correct them.

Procedure

1. Wet the sponge. Squeeze out excess water.

2. Lay the sponge on the board (fig. 1). The board represents good bearing soil. The sponge represents an upper soil layer that is very soft or marshy. This upper layer is not a good bearing surface.
3. Stand the brick on end on the sponge. Because the upper soil (sponge) is not a good bearing surface, the structure settles unevenly. It sinks, tilts, and eventually falls (fig. 2).
4. Now you will put a foundation under the structure. Hold the brick on the sponge. Make a small dot on the sponge at each corner of the brick.
5. Drive a nail? in from each dot. The nails should be driven until their heads are just under the top of the sponge (see fig. 3). The nails represent capped piles.
6. Place the brick (structure) on the nails (pile caps). There is no settling because the weight of the structure is supported by the pile caps. Keep in mind that pile caps can be used to overcome poor soil conditions.
7. Saw the 3/4" x 6" x 12" board for use as the bearing surface for the pile cap foundation.
8. Saw the plywood pieces for use as the slab foundations.
9. Make the foundation wall out of sheet metal (see fig. 4).
10. Make the spread footings (see fig. 5).
11. Obtain a plastic box or dishpan. It must be deep enough to hold 3" of sand and large enough that a 5" square piece of wood can fit into it.
12. Place the metal frame (foundation wall) on edge in the box of sand. This represents a foundation wall resting on a bearing surface with no footing (see fig. 6).
13. Lay the brick on top of the metal foundation wall. The brick represents the dead load of the structure. Press down on the brick to represent the live load. The foundation wall sinks into the bearing surface. With no footing, it settles unevenly and eventually cracks and collapses.
14. Now you will put a spread footing under the foundation wall. Put the footing on the sand. Set the metal foundation wall on the footing (see fig. 7).
15. Put the brick on top of the metal and push down.
16. Remove the brick, metal foundation wall, and wood footing from the sand. What happened to the bearing surface under the footing?
17. Smooth out the sand in the box.
18. Place the slab footing in the box. Set the metal foundation wall on the slab (see fig. 8).
19. Put the brick on the wall and push down. Did the wall settle more with the spread footing or the slab footing?
20. Carefully lift the brick, wall, and slab out of the box. What does the sand under the slab look like? How does the sand under the slab footing compare with the sand under the spread footing?
21. Study the "Bearing Capacity Average Safe Load of Soil" chart. Participate in a discussion on determining the proper foundation for different types of soil.
22. After the class has completed the discussion, fill out the evaluation sheet.

Evaluation

- You will graded on your behavior and participation during the activity and discussion.
- You will also be required to turn in the evaluation sheet for a grade.

Safety Awareness

1. Be careful when using hand tools.
2. Sheet metal has sharp edges. Be careful.
3. Wear eye protection.

EXPERIENCING THE MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS

Essential Elements:	75.50(b): 1A, 2C, 2D, 3A, 4A, 4B, 6A, 6B, 6D, 8A, 8B 75.50(g): 1B, 1F, 2C-F
TAAS Objectives:	Language Arts: RC 1-6; WC 1-4, 6 Mathematics: C 1-5; O 1-4; PS 1-4

Activity Overview

Through this activity students will become familiar with different structural materials and the mechanical properties that qualify these materials to be used in construction.

Challenge Statement

There are hundreds of materials that are useful to people for many different purposes. Only a few of those materials are practical as structural materials because of the strength and durability required in construction.

All construction materials must pass stringent tests to ensure the safety of those using the facilities. Standards are set which dictate the mechanical properties necessary for a material to be used in construction. Through this activity, your students will have the opportunity to experiment with different structural materials to help them understand material properties and the importance of testing materials and setting standards for their use.

Systems Model

Resources
Students as engineers and experimenters
Instructor as resource person and monitor
Structural materials
Standard construction tools
Materials testing supplies

Processes
Tensile strength testing
Compression strength testing
Elasticity testing
Plasticity testing
Brittleness testing
Toughness testing
Observation of testing demonstrations
Recording observations
Discussion of mechanical properties, test results, and the utility of structural materials

Application
Knowledge of durability to material testing
Materials testing results to deductions about mechanical properties
Information about mechanical properties to deductions about structural materials' utility
Structural materials to safety

Impact
Career options
Appropriate materials use in construction
Safety in construction

Interfacing with Other Disciplines

Language Arts: Students will learn the meaning of new words and concepts relating to construction. They will experiment and record their results in writing.

Mathematics: Students will design experiments in a problem-solving situation and record their results. Much of their testing will require weight and linear measurements.

Science: Students will experiment with and study the physical properties of materials.

Social Studies: Students will realize the importance of material standards in the construction of containment, shelter, and support structures for society.

Critical Thinking Skills Reinforced

Through experimentation, students will draw conclusions about the mechanical properties of structural materials. They will apply these deductions to generalizations about the utility and safety of construction materials and the need for standards in construction.

Teaching Tips

1. Make transparencies of all support forms to aid in discussion.
2. Assemble all tools, supplies, and equipment for easy access to the students. Encourage proper safety procedures.
3. For your final discussion, have current trends in construction available from different magazines. The students will be interested in new trends, especially with plastics and glass. The school librarian would be a good resource person for current information.

Instructional Strategy

- Open the class by directing students to the proper definitions of the structural terms.
- Encourage creativity in designing the materials testing experiments.
- Guide the students toward application of the test results and the uses of the various materials.

Equipment/Supplies

1. Vise
2. Folding bars
3. Metal strips
4. Concrete blocks
5. Scale
6. Hammer
7. Wood strips
8. Bricks
9. Bucket and sand
10. Common tools found in a construction lab

Evaluation Key

Your students should define these basic concepts.

Tensile strength—the ability of a material to resist stretching or pulling apart divided by the tensile force applied to the material.

$$\text{Tensile strength} = \frac{\text{stretching resistance}}{\text{tensile forces}}$$

Compression strength—the ability of a material to resist inward pressure divided by the inward forces applied to the material.

$$\text{Compression strength} = \frac{\text{compression resistance}}{\text{compression forces}}$$

Elasticity—the ability of a material to return to its original form after the force is ended.

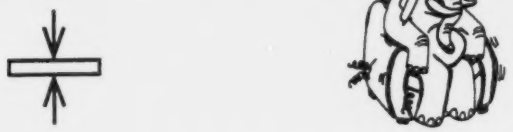
Plasticity—the ability of a material to maintain a new shape and form. This is especially useful in insulation materials.
Brittleness—the opposite of plasticity. The material will break as it passes its degree of elasticity.
Toughness—the amount of force a material can absorb before it breaks.

Support Materials
1. Mechanical Properties of Materials form
2. Demonstration of the Mechanical Properties of Materials form
3. Positive Mechanical Properties of Structural Materials form
4. Any production or construction textbook

Modification for Handicapped, Disadvantaged, and LEP Students
Students with special needs may need assistance recording the results of the experiments. The group the student is assigned to must be sensitive to and patient with his needs.

Name_____

Mechanical Properties of Materials

Property	*Pictorial Description*	*Definition*
Tensile strength		
Compression strength		
Elasticity		
Plasticity		
Brittleness		
Toughness		

Name_____

Demonstration of the Mechanical Properties of Materials

(1) For each property, describe the demonstration, and tell why you think it was good for that particular mechanical property. (2) Describe a test you would perform to demonstrate the property yourself.

Tensile strength
(1)

(2)

Compression strength
(1)

(2)

Elasticity
(1)

(2)

Plasticity
(1)

(2)

Brittleness
(1)

(2)

Toughness
(1)

(2)

Name_____

Positive Mechanical Properties of Structural Materials

(1) For each material, describe the mechanical properties that apply to the material that make it useful in construction. (2) Describe its main use in the construction industry.

Wood
(1)

(2)

Metals (iron and steel)
(1)

(2)

Concrete
(1)

(2)

Stone
(1)

(2)

Plastic
(1)

(2)

Fiberglass
(1)

(2)

EXPERIENCING THE MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS

Become familiar with different structural materials and the mechanical properties that qualify these materials to be used in construction.

Challenge Statement

There are hundreds of materials that are useful to people for many different purposes. Only a few of those materials are practical as structural materials because of the strength and durability required in construction.

All construction materials must pass stringent tests to ensure the safety of those using the facilities. Standards are set which dictate the mechanical properties necessary for a material to be used in construction. Through this activity, you will have the opportunity to experiment with different structural materials.

Objectives

- To understand the material properties that affect construction
- To recognize appropriate structural materials
- To understand the relationship between mechanical properties and structural utility

Vocabulary/Concepts Reinforced

- Tensile strength
- Elasticity
- Brittleness
- Structural materials
- Compression strength
- Plasticity
- Thermal properties
- Chemical properties

Equipment/Supplies

- Vise
- Folding bars
- Metal strips
- Concrete blocks
- Scale
- Hammer
- Wood strips
- Bricks
- Bucket and sand
- Common tools found in a construction lab

Introduction

Only a few materials can stand up to the demands of construction. Most structural materials are natural, including wood, concrete, stone, and brick. Plastics and fiberglass are two synthetic materials in use, but more synthetic materials are being developed for construction every day. Metals are the third group of commonly used structural materials. Each of these materials has special qualities that contribute to its usefulness in the building industry.

The quality of the materials relate to *strength* and *durability*. Some of the major mechanical properties are tensile strength, compression strength, elasticity, plasticity, brittleness, and toughness. Two other important considerations in material properties are thermal and chemical properties.

Using the wrong materials for a job can result in injury and a loss of time and money. Standards are set in construction to ensure the proper use of materials. Before the standards are set, the materials must pass a series of mechanical tests.

Procedure

1. Study the pictures on the Mechanical Properties of Materials page. From the pictorial description, write a definition of each of the mechanical properties. Discuss the mechanical properties with the class.
2. Your teacher will divide the class into six groups and assign each group one of the mechanical properties of materials. With your group, devise a test to demonstrate your mechanical property. Perform your test within your group on two different structural materials.
3. Each group will demonstrate their tests to the rest of the class. Fill in the Demonstration of the Mechanical Properties of Materials form as you observe each demonstration.
4. Review the most commonly used structural materials. They are wood, concrete, stone, brick, plastics, fiberglass, and metals. Describe the mechanical properties each material possesses which make it most useful in construction, and fill in the Positive Mechanical Properties of Structural Materials form.
5. Discuss combining materials to maximize support, as concrete and steel for foundations. What other examples can you think of. Discuss these questions. Why don't we use wooden pegs as nails? Which material tolerates more heat, wood, steel or concrete? How could you maximize heat tolerance? What materials make the best roofing? How do we use plastics in construction?

Evaluation

You will be graded on the accuracy, neatness, and completion of the Mechanical Properties of Materials, Demonstration of the Mechanical Properties of Materials, and Positive Mechanical Properties of Structural Materials forms.

THE SIZE AND SHAPE OF STRUCTURAL MATERIALS

Essential Elements: 75.50(b): 1C, 1D, 4A, 4B, 5A, 6A, 6D, 8A, 8B
75.50(g): 1A, 1F, 1G, 2B-G

TAAS Objectives: Language Arts: RC 1-6
Mathematics: C 1-5; O 1, 3; PS 1-4

Activity Overview

Your students will review many of the different shapes and sizes of structural materials and conduct experiments to help them understand why different shapes and sizes are used in construction.

Challenge Statement

Spanning large distances, catching and diverting water, and supporting heavy weights are all necessary in construction. A 2x4 cannot do it all. Different shapes and sizes are necessary to successfully accomplish all the jobs in construction. New shapes and sizes of materials are being developed (often using new materials) to make the construction process easier.

Your students will experiment with different shapes to determine the impact shape and size have on construction.

Systems Model

Resources
Students as designers and experimenters
Instructors as resource person, monitor and evaluator
Shapes and Sizes of Construction Materials form
Materials necessary to build support blocks

Processes
Observation and study of the Shapes and Sizes of Construction Materials form and samples
Design of structural block
Load test on block
Evaluation of block based on support and shape
Deductions about structural materials

Applications
Creative problem solving to a structural support problem
Deductions about strength to the shape and size of structural materials
Shape to utility of building materials

Impact
Safe building structures
Creativity in problem solving
Understanding the construction industry

Interfacing with Other Disciplines

Language Arts: Students will learn the meaning of new words and supporting ideas.

Mathematics: Students will use both weight and linear measurement to solve a problem. They will express their solution in numerical terms.

Science: Students will study, experiment with, and understand the impact of manipulating materials to solve a problem

Social Studies: Students will develop a better understanding of construction processes and materials used in construction to house society and provide jobs.

Critical Thinking Skills Reinforced

Through a problem-solving situation, students will make conclusions about the function of different shapes and sizes in construction. They will experiment with different shapes, compare results, and draw conclusions about strength and utility. They will transfer this information to the building industry.

Teaching Tips

1. Have enough copies of the Shapes and Sizes of Construction Materials form for each student and a transparency to use during discussion.
2. Have as many samples on hand as possible. A lumberyard would probably donate samples of the different types of molding and sizes of lumber.
3. Determine the amount of material you will allow each student. A one-foot square of posterboard would be sufficient. Allow the students to design their own blocks without coaching.
4. If you can secure more than one scale, set up additional weighing stations to save time. If you are concerned about accuracy, use the same scale for all students.
5. If you have more than one class, you may want to leave all the blocks out for comparison between classes.
6. The student with the highest load could receive extra points or a prize of your choice.

Instructional Strategy

- Open the class with observation and study of the Shapes and Sizes of Construction Materials form.
- Allow the students creative license in their block design.
- Supervise the weight stations/s.
- Evaluate the blocks individually to guide the students toward deductions about structural materials.
- Close the class with comparisons of the different-shaped blocks.

Equipment/Supplies

1. Posterboard or heavy paper
2. Scissors or paper cutter
3. Masking tape
4. Ruler
5. Sand
6. Coffee cans or small container
7. Scale

Evaluation Key

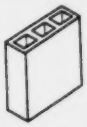
Grade each student on how well he or she followed directions and the configuration of his/her block and the load it held.

Support Materials

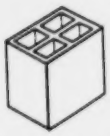
1. Horton, A., et al. *Exploring Construction Systems*. Worcester, Mass.: Davis Publishing, 1991.
2. Kasicki, O. *The Resources and Projects Book: A Student Guide to Design and Techonlogy*. Albany, N.Y.: Delmar, 1991.
3. *Ties Magazine*. Philadelphia: Drexel University, March-April, 1992.

Shapes and Sizes of Construction Materials

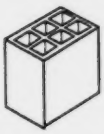
Structural Support Blocks



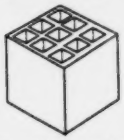
4" or 6" × 12" × 12"



6" or 8" × 12" × 12"



8" or 10" × 12" × 12"



12" × 12" × 12' or
8' × 8' × 8"

6" × 8": × 12"

6" or 8" × 5 1/3" × 12"

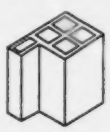
8" or 12" × 5 1/3" × 12"

4" × 5" × 12"

8" × 8" × 12"

8" × 8" × 12"

8" × 8" × 12"



6" or 8" × 10" × 12" × 12"

12" × 12" × 12"

2" or 4" × 12" × 12"

1" or 2" × 12" × 12"- Split

Structural Steel Shapes

American
Standard
Beams

American
Standard
Channels

Angles-Equal
Legs

Bulb
Angles

Tees

Elevator Tees

Wall Tees

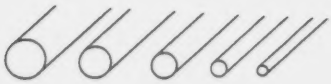
Zees

Wooden Structural Materials

Shaped boards

Moldings

Dowels



Veneers

Synthetic boards

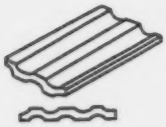
Plywood

Particleboard

Blockboard

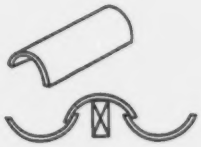
Hardboard

Available Roofing Tiles

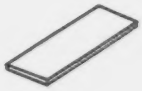


French Tile

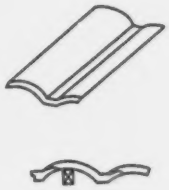
English Tile



Mission Tile

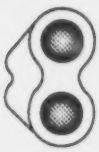


Shingle Tile

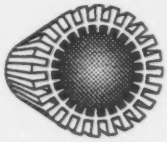


Spanish Tile

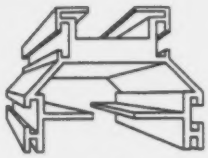
Samples of Extruded Metal Stock



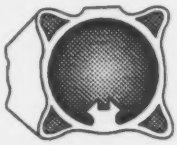
1



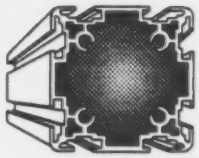
2



3



4



5

THE SIZE AND SHAPE OF STRUCTURAL MATERIALS

Review many of the different shapes and sizes of structural materials, and conduct an experiment to help you understand why different shapes and sizes are used in construction.

Challenge Statement

Spanning large distances, catching and diverting water, and supporting heavy weights are all necessary in construction. A 2x4 cannot do it all. Different shapes and sizes are necessary to successfully accomplish all the jobs in construction. New shapes and sizes of materials are being developed, often using new materials, to make the construction process easier.

You will experiment with different shapes to determine the impact shape and size have on construction.

Objectives

- To become familiar with many different shapes, sizes, and uses of materials in construction
- To experiment with different shapes to support weight
- To realize the diversity in construction materials

Vocabulary/Concepts Reinforced

- Structural clay tile
- Roofing tiles
- Moldings
- Veneer
- Structural steel
- Extrusion process
- Dowels
- Boards

Equipment/Supplies

- Posterboard or heavy paper
- Scissors or paper cutter
- Masking tape
- Ruler
- Sand
- Coffee cans or small container
- Scale

Introduction

Many construction materials can be shaped and formed to be more useful in construction. Even wood takes on different shapes and sizes. We are most familiar with the 2x4, but that is just one type of board in construction.

Building materials basically have three different purposes: structural support, utility, and appearance. The most obvious function is structural support for holding up the walls and the roof. Some building materials have a particular job other than support, as pipes to carry water or roofing material to protect us from the elements. Appearance is an important job for materials in construction. The shape of moldings and tiles adds to the overall look of the finished product.

Procedure

1. Study the shapes, sizes, materials, and uses of the construction materials on the Shapes and Sizes of Construction Materials form. Compare the shapes and sizes to the job. Are the materials that support weight different from those that are made to enhance the appearance of the finished products? Does the shape of the material indicate how the stock will be used?

2. On a piece of paper, sketch a block you will make with posterboard or paper to support weight. Show your design to your instructor, pick up your building materials, and make your block. You may only use the materials your instructor gives you. Use only one layer of tape at the joints.
3. Give the dimensions of your block on your sketch. Take your block to a testing station, and conduct a load test. Put the can on your block, and add sand very slowly. When your block breaks, weigh the can with the sand to determine the weight your block held. Write the size of your block, the weight it held, and your name on the block itself.
4. Put all the blocks on a table, and compare weights and configurations. How does the shape of the block influence how much weight it can hold? Does the position of the block make a difference? Would a combination of different shapes and sizes be useful?

Evaluation
You will be graded on how well you followed directions, the configuration of your block, and the load it held.

ESTIMATING HOME COSTS AND AFFORDABILITY

Essential Elements: 75.50(b): 2A, 3A, 6A, 6B, 8A
75.50(g): 1B, 2A, 2C, 2D

TAAS Objectives: Language Arts: RC 1-6; WC 1-4
Mathematics: C 1-3; O 1, 3, 4; PS 1-4

Activity Overview

Your students will choose a practical but comfortable home, and determine the square footage and cost based on the cost per square foot. They will then determine the monthly payment and the level of job necessary to support the payments.

Challenge Statement

Sometimes our dreams and needs are bigger than our income. With the cost of homes escalating every year, many people cannot afford homes for themselves and their families. This activity is designed to make your students aware of the cost of housing and the income they will need to buy or build a home.

Interfacing with Other Disciplines

Language Arts: Students will learn the meanings of new words and concepts. They will record their conclusions in written form.

Mathematics: Students will use basic math functions to answer a real-life question. They will use numbers to value a home, then determine an income range to provide for the payments. From this realization, they will become aware of career fields necessary to support their lifestyle.

Social Studies: Students will develop a real-life understanding of the requirements of home ownership. They will understand the relationship between training, work, and lifestyle.

Critical Thinking Skills Reinforced

The students will draw conclusions about work and lifestyle from prioritizing and calculating the costs of home ownership. They will apply this information to personal career training and opportunities.

Teaching Tips

1. Have ample numbers and styles of house plans for the students to study and choose.
2. It would be helpful and save time if the students brought calculators to class for this exercise.
3. Transparencies of the forms would be helpful for group explanations.
4. The focus of the activity is to help the students realize their responsibility and expense of home ownership. This awareness may trigger some thought into the future as far as career training and opportunities go.

Instructional Strategy

- Open the class by discussing homes for the students and their future families.
- Assist and instruct the students through the calculations on the forms.
- Lead the students to an understanding of the responsibilities ahead of them and the need to consider and plan long-term career goals.

Equipment/Supplies

1. Floor plans
2. Checklist for Suburban Building Lot form
3. Estimating House Costs form
4. Determining the Mortgage Payment form
5. Amortization tables
6. Architect's scale
7. Telephone and directory

Evaluation Key

Grade your students on the neatness and accuracy of their Checklist for Suburban Building Lot form, Estimating House Costs form, and Determining the Mortgage Payment form.

Modifications for Handicapped, Disadvantaged, and LEP Students

Some students may need help with the math calculations. Students finishing quickly can peer teach those students who need assistance.

Estimating House Costs

1. Lot cost (Transfer this total from the Checklist for Suburban Building Lot or from the information from the salesperson in the neighborhood you choose.) (A)_____

2. Square footage (put an *X* next to the appropriate rooms):

	Rooms	Size	Square Feet
_____	Living room	_____	_____
_____	Dining room	_____	_____
_____	Kitchen	_____	_____
_____	Laundry room	_____	_____
_____	Entrance or Foyer	_____	_____
_____	Master Bedroom	_____	_____
_____	Bedroom 1	_____	_____
_____	Bedroom 2	_____	_____
_____	Bedroom 3	_____	_____
_____	Bedroom 4	_____	_____
_____	Master Bathroom	_____	_____
_____	Bathroom 1	_____	_____
_____	Bathroom 2	_____	_____
_____	Den/Family room	_____	_____
_____	Formal Living room	_____	_____
_____	_____		_____
_____	_____		_____
_____	_____		_____
_____	_____		_____

Total square feet = _____

3. Total sq. ft. × $60 = (B)_____
4. garage dimension_____ sq. ft. in garage_____
   square footage in garage × $10 = cost of garage (C)_____

Add up (A), (B), and (C) to get the total cost of the house.

Total home cost_____

You can calculate landscaping at 10% of the cost of the home. This can be added into the total to be financed.

Total with landscaping_____

Determining the Mortgage Payment

1. The total cost of the house is $_____

2. The lending agency will require a 20% down payment.
   (20% of the total cost of the house) -$_____

3. The lending agency will finance the remaining 80% of the house. $_____

4. Use the amortization table to determine the monthly payment at 12% interest to be paid out over 30 years.

   The monthly payment is $_____

5. Determine the property taxes at 1% of the total cost of the house.
   Total cost of house_____ × 0.01 =_____ $_____

6. Divide this number by twelve (months) to determine the amount to add to your monthly mortgage payments.

   _____ ÷ 12 = $_____

7. Determine the homeowner's insurance payments at 1/2% of the total cost of the house = $_____. Divide this amount by 12 to determine the monthly payment to add to the monthly mortgage payment.

   _____ ÷ 12 = $_____

8. To determine the total monthly payment, add the mortgage payment, the monthly property tax payment, and the monthly homeowner's insurance payment.

   Total monthly payment $_____

9. To afford this home, the monthly payment must not exceed 1/3 of the monthly income for the household. Multiply the total monthly payment by three to determine the minimum monthly income required to afford this house.

   _____ × 3 = Required monthly income$_____

10. Multiply the above number by twelve to determine the minimum annual income to afford the house.

    _____ × 12 = Required annual income $_____

11. What type of career would provide that income?

12. What kind of training would you need to be qualified for the position?

PART ONE	Suburban lot	X	
			6
Where do you want your house? (Check one.)	Corner of block	___	10
	Middle of block	___	9
What topography do you want? (Check one.)	Hilly	___	10
	Sloping	___	9
	Level	___	7
How big a lot do you want? (Check one.)	75′ x 100′	___	8
	100′ x 150′	___	9
	100′ x 200′	___	10
What utilities would you like? (Check as many as desired.)	Telephone lines	___	1
	Electrical lines	___	1
	Public water	___	1
	Sanitary sewer	___	1
	Storm sewer	___	1
	Natural gas	___	1
What services do you want within 5 miles? (Check as many as desired.)	Fire protection	___	1
	Police protection	___	1
	Hospital	___	1
	Church	___	1
	Elementary school	___	1
	Junior high school	___	1
	High school	___	1
	Shopping	___	1
What zone would be best for you? (Check one.)	Residential (one family)	___	10
	Residential (two or more)	___	9
	Residential & industrial	___	8
	Residential & commercial	___	8

PART TWO

At the right is a column of numbers.

Cross out numbers for items *not* checked.

Then add. Write the sum here.

Copy it here. → $.....

Multiply by 300. This is what your lot will cost. x 300

$.....

171

AMORTIZATION TABLE

12%

MONTHLY PAYMENT NECESSARY TO AMORTIZE A LOAN

TERM / AMOUNT	24 YEARS	25 YEARS	26 YEARS	27 YEARS	28 YEARS	29 YEARS	30 YEARS	35 YEARS	40 YEARS
$ 50	54	53	53	53	52	52	52	51	51
100	1 07	1 06	1 06	1 05	1 04	1 04	1 03	1 02	1 01
200	2 13	2 11	2 10	2 09	2 08	2 07	2 06	2 04	2 02
300	3 19	3 16	3 15	3 13	3 11	3 10	3 09	3 05	3 03
400	4 25	4 22	4 19	4 17	4 15	4 13	4 12	4 07	4 04
500	5 31	5 27	5 24	5 21	5 19	5 17	5 15	5 08	5 05
600	6 37	6 32	6 29	6 25	6 22	6 20	6 18	6 10	6 06
700	7 43	7 38	7 33	7 30	7 26	7 23	7 21	7 11	7 06
800	8 49	8 43	8 38	8 34	8 30	8 26	8 23	8 13	8 07
900	9 55	9 48	9 43	9 38	9 33	9 30	9 26	9 14	9 08
1000	10 61	10 54	10 47	10 42	10 37	10 33	10 29	10 16	10 09
1100	11 67	11 59	11 52	11 46	11 41	11 36	11 32	11 18	11 10
1200	12 73	12 64	12 57	12 50	12 44	12 39	12 35	12 19	12 11
1300	13 78	13 70	13 62	13 54	13 48	13 43	13 38	13 21	13 12
1400	14 85	14 75	14 66	14 58	14 52	14 46	14 41	14 22	14 12
1500	15 91	15 80	15 71	15 63	15 55	15 49	15 43	15 24	15 13
1600	16 97	16 86	16 76	16 67	16 59	16 52	16 46	16 25	16 14
1700	18 03	17 91	17 80	17 71	17 63	17 56	17 49	17 27	17 15
1800	19 09	18 96	18 85	18 75	18 66	18 59	18 52	18 28	18 16
1900	20 15	20 02	19 90	19 79	19 70	19 62	19 55	19 30	19 17
2000	21 21	21 07	20 94	20 83	20 74	20 65	20 58	20 32	20 17
2100	22 27	22 12	21 99	21 88	21 77	21 68	21 61	21 33	21 18
2200	23 33	23 18	23 04	22 92	22 81	22 72	22 63	22 35	22 19
2300	24 39	24 23	24 08	23 96	23 85	23 75	23 66	23 36	23 20
2400	25 45	25 28	25 13	25 00	24 88	24 78	24 69	24 38	24 21
2500	26 51	26 34	26 18	26 04	25 92	25 81	25 72	25 39	25 22
2600	27 57	27 40	27 23	27 08	26 96	26 85	26 75	26 41	26 24
2700	28 63	28 45	28 27	28 13	27 99	27 88	27 78	27 44	27 25
2800	29 69	29 51	29 32	29 17	29 03	28 92	28 81	28 47	28 27
2900	30 75	30 57	30 37	30 21	30 07	29 95	29 84	29 49	29 28
3000	31 81	31 62	31 42	31 25	31 10	30 98	30 87	30 47	30 29
3100	32 87	32 68	32 46	32 29	32 14	32 01	31 89	31 52	31 31
3200	33 93	33 73	33 51	33 33	33 18	33 04	32 92	32 55	32 33
3300	34 99	34 79	34 56	34 38	34 21	34 07	33 95	33 58	33 35
3400	36 05	35 84	35 61	35 42	35 25	35 10	34 98	34 60	34 37
3500	37 12	36 90	36 66	36 46	36 29	36 14	36 01	35 63	35 39
3600	38 18	37 96	37 71	37 50	37 33	37 17	37 04	36 65	36 41
3700	39 24	39 01	38 76	38 54	38 36	38 21	38 07	37 68	37 43
3800	40 30	40 07	39 81	39 58	39 40	39 24	39 10	38 70	38 45
3900	41 36	41 12	40 86	40 63	40 44	40 28	40 13	39 73	39 47
4000	42 42	42 18	41 91	41 67	41 47	41 30	41 15	40 75	40 49
4100	43 48	43 23	42 96	42 71	42 51	42 34	42 18	41 77	41 51
4200	44 54	44 29	44 01	43 75	43 55	43 37	43 21	42 80	42 53
4300	45 60	45 34	45 06	44 79	44 58	44 40	44 24	43 82	43 55
4400	46 66	46 40	46 11	45 84	45 62	45 43	45 26	44 84	44 57
4500	47 72	47 45	47 12	46 87	46 65	46 46	46 29	45 70	45 59
4600	48 78	48 51	48 17	47 92	47 69	47 49	47 31	46 87	46 61
4700	49 84	49 56	49 22	48 96	48 73	48 52	48 34	47 91	47 63
4800	50 90	50 62	50 27	50 00	49 76	49 55	49 36	48 93	48 65
4900	51 96	51 67	51 33	51 04	50 80	50 58	50 39	49 96	49 67
5000	53 02	52 67	52 33	52 08	51 84	51 62	51 44	50 78	50 43
5100	54 08	53 73	53 38	53 13	52 88	52 66	52 47	51 82	51 47
5200	55 14	54 78	54 44	54 17	53 92	53 70	53 50	52 86	52 51
5300	56 20	55 84	55 49	55 21	54 96	54 74	54 53	53 90	53 55
5400	57 26	56 90	56 55	56 25	56 00	55 77	55 57	54 94	54 59
5500	58 33	57 95	57 59	57 29	57 03	56 78	56 58	55 98	55 47
5600	59 39	58 99	58 64	58 33	58 07	57 85	57 62	57 01	56 51
5700	60 45	60 04	59 68	59 38	59 11	58 89	58 66	58 05	57 55
5800	61 51	61 09	60 74	60 42	60 15	59 93	59 71	59 09	58 59
5900	62 57	62 15	61 79	61 46	61 19	60 96	60 75	60 13	59 63
6000	63 63	63 20	62 82	62 46	62 20	61 95	61 72	60 64	60 51
6100	64 69	64 26	63 85	63 50	63 24	62 99	62 76	62 16	61 55
6200	65 75	65 31	64 90	64 54	64 28	64 03	63 80	63 20	62 59
6300	66 81	66 37	65 96	65 58	65 32	65 07	64 84	64 24	63 63
6400	67 87	67 42	67 01	66 63	66 36	66 11	65 88	65 28	64 67
6500	68 93	68 48	68 06	67 70	67 36	67 11	66 84	66 02	65 56
6600	69 99	69 53	69 11	68 75	68 40	68 15	67 92	67 31	66 71
6700	71 05	70 59	70 17	69 79	69 44	69 19	68 96	68 35	67 75
6800	72 11	71 64	71 22	70 83	70 48	70 23	69 99	69 39	68 79
6900	73 17	72 70	72 27	71 87	71 52	71 27	71 03	70 43	69 83
7000	74 23	73 73	73 29	72 91	72 57	72 27	72 01	71 09	70 80
7100	75 29	74 78	74 33	73 96	73 61	73 31	73 08	72 46	71 84
7200	76 35	75 84	75 38	75 00	74 65	74 35	74 12	73 50	72 88
7300	77 41	76 89	76 44	76 04	75 69	75 39	75 16	74 54	73 92
7400	78 47	77 95	77 49	77 08	76 73	76 43	76 20	75 58	74 96
7500	79 53	79 00	78 53	78 11	77 75	77 43	77 15	76 17	75 64
7600	80 59	80 06	79 57	79 15	78 79	78 47	78 23	77 21	76 68
7700	81 65	81 11	80 61	80 19	79 83	79 51	79 27	78 25	77 72
7800	82 71	82 17	81 65	81 23	80 87	80 55	80 31	79 29	78 76
7900	83 77	83 22	82 69	82 27	81 91	81 59	81 35	80 33	79 80
8000	84 84	84 28	83 78	83 32	82 93	82 59	82 29	81 25	80 68
8100	85 90	85 33	84 82	84 36	83 97	83 63	83 33	82 29	81 72
8200	86 96	86 39	85 86	85 40	85 01	84 67	84 37	83 33	82 76
8300	88 02	87 44	86 90	86 44	86 05	85 71	85 41	84 37	83 80
8400	89 08	88 50	87 94	87 48	87 09	86 75	86 45	85 41	84 84
8500	90 14	89 55	88 98	88 52	88 13	87 79	87 49	86 45	85 88
8600	91 20	90 61	90 03	89 56	89 17	88 83	88 53	87 49	86 92
8700	92 26	91 66	91 07	90 60	90 21	89 87	89 57	88 53	87 96
8800	93 32	92 72	92 11	91 64	91 25	90 91	90 61	89 57	89 00
8900	94 38	93 77	93 15	92 68	92 29	91 95	91 65	90 61	90 04
9000	95 44	94 80	94 23	93 74	93 30	92 92	92 58	91 40	90 77
9100	96 50	95 86	95 27	94 78	94 34	93 96	93 62	92 44	91 81
9200	97 56	96 91	96 31	95 81	95 38	95 00	94 66	93 48	92 85
9300	98 62	97 97	97 35	96 85	96 42	96 04	95 70	94 52	93 89
9400	99 68	99 02	98 39	97 89	97 46	97 08	96 74	95 56	94 93
9500	100 74	100 08	99 47	98 94	98 48	98 08	97 72	96 48	95 81
10000	106 04	105 33	104 70	104 15	103 67	103 24	102 87	101 56	100 85
10500	111 34	110 59	109 93	109 36	108 84	108 37	107 96	106 64	105 89
11000	116 65	115 86	115 17	114 56	114 00	113 50	113 15	111 72	110 94
11500	121 95	121 12	120 40	119 77	119 16	118 63	118 24	116 80	115 98
12000	127 26	126 39	125 64	124 98	124 40	123 89	123 44	121 87	121 02
12500	132 56	131 65	130 87	130 19	129 56	129 02	128 53	126 95	126 06
13000	137 87	136 92	136 11	135 39	134 76	134 21	133 72	132 03	131 11
14000	148 48	147 46	146 58	145 81	145 13	144 54	144 01	142 18	141 19
15000	159 08	157 99	157 06	156 22	155 50	154 86	154 30	152 34	151 28
16000	169 69	168 52	167 53	166 64	165 86	165 18	164 58	162 49	161 36
17000	180 27	179 05	177 99	177 06	176 23	175 51	174 87	172 65	171 45
18000	190 87	189 58	188 46	187 47	186 60	185 83	185 16	182 80	181 53
19000	201 48	200 12	198 93	197 88	196 96	196 15	195 44	192 96	191 62
20000	212 08	210 66	209 40	208 29	207 33	206 48	205 73	203 11	201 70
21000	222 68	221 19	219 87	218 71	217 69	216 80	216 01	213 27	211 79
22000	233 29	231 73	230 33	229 12	228 06	227 12	226 30	223 43	221 87
23000	243 89	242 26	240 80	239 53	238 43	237 45	236 59	233 59	231 96
24000	254 49	252 80	251 27	249 95	248 79	247 77	246 87	243 74	242 04
25000	265 10	263 31	261 74	260 37	259 16	258 09	257 16	253 89	252 13
26000	275 70	273 84	272 21	270 78	269 50	268 42	267 44	264 05	262 21
27000	286 31	284 38	282 68	281 20	279 89	278 74	277 73	274 20	272 30

INDIANA STATE LIBRARY

12%

MONTHLY PAYMENT NECESSARY TO AMORTIZE A LOAN

TERM / AMOUNT	24 YEARS	25 YEARS	26 YEARS	27 YEARS	28 YEARS	29 YEARS	30 YEARS	35 YEARS	40 YEARS
$ 27500	291 81	289 84	287 92	286 40	285 07	283 90	282 87	279 28	277 34
28000	296 91	294 91	293 15	291 61	290 26	289 07	288 02	284 38	282 38
28500	302 21	300 17	298 38	296 82	295 44	294 23	293 18	289 44	287 43
29000	307 52	305 44	303 60	302 03	300 63	299 40	298 33	294 51	292 47
29500	312 82	310 71	308 83	307 23	305 81	304 56	303 45	299 59	297 51
30000	318 12	315 97	314 06	312 44	310 99	309 71	308 59	304 67	302 55
30500	323 42	321 24	319 29	317 65	316 17	314 87	313 73	309 75	307 60
31000	328 72	326 50	324 52	322 85	321 36	320 04	318 87	314 83	312 64
31500	334 03	331 77	329 80	328 06	326 54	325 20	324 02	319 90	317 68
32000	339 33	337 04	335 03	333 27	331 72	330 36	329 16	324 98	322 72
32500	344 63	342 30	340 26	338 48	336 90	335 52	334 30	330 06	327 77
33000	349 93	347 57	345 50	343 68	342 09	340 68	339 45	335 14	332 81
33500	355 23	352 84	350 73	348 89	347 27	345 85	344 59	340 21	337 85
34000	360 53	358 10	355 97	354 10	352 45	351 01	349 73	345 29	342 89
34500	365 84	363 37	361 20	359 30	357 64	356 17	354 88	350 37	347 94
35000	371 14	368 83	366 44	364 51	362 82	361 33	360 02	355 45	352 98
35500	376 44	373 90	371 67	369 72	368 00	366 49	365 18	360 53	358 02
36000	381 74	379 17	376 91	374 93	373 19	371 65	370 31	365 80	363 06
36500	387 04	384 43	382 14	380 13	378 37	376 82	375 45	370 88	368 11
37000	392 35	389 70	387 38	385 34	383 55	381 98	380 59	375 76	373 15
37500	397 65	394 96	392 61	390 55	388 73	387 14	385 73	380 84	378 19
38000	402 95	400 23	397 85	395 76	393 92	392 30	390 87	385 91	383 23
38500	408 25	405 50	403 08	400 98	399 10	397 46	396 01	390 99	388 28
39000	413 55	410 76	408 32	406 17	404 28	402 62	401 16	396 07	393 32
39500	418 86	416 03	413 55	411 39	409 47	407 79	406 31	401 15	398 36
40000	424 16	421 29	418 79	416 58	414 65	412 95	411 45	406 22	403 40
40500	429 46	426 56	424 02	421 78	419 83	418 11	416 58	411 30	408 45
41000	434 76	431 83	429 26	427 00	425 02	423 27	421 74	416 38	413 49
41500	440 06	437 09	434 49	432 21	430 20	428 43	426 88	421 46	418 53
42000	445 37	442 36	439 73	437 41	435 38	433 60	432 02	426 54	423 57
42500	450 67	447 63	444 96	442 62	440 57	438 78	437 17	431 61	428 62
43000	455 97	452 89	450 19	447 83	445 75	443 92	442 31	436 69	433 66
43500	461 27	458 16	455 43	453 04	450 93	449 08	447 45	441 77	438 70
44000	466 57	463 42	460 66	458 24	456 11	454 24	452 58	446 85	443 74
44500	471 87	468 69	465 90	463 45	461 30	459 40	457 74	451 92	448 79
45000	477 18	473 96	471 13	468 66	466 48	464 57	462 88	457 00	453 83
45500	482 78	484 49	481 80	479 07	476 85	474 89	473 17	467 18	463 91
47000	488 38	486 02	482 07	488 49	487 21	485 21	483 45	477 31	474 00
46500	508 98	508 55	502 84	499 90	497 58	495 54	493 74	487 47	484 08
46000	519 59	518 08	513 01	510 31	507 95	505 86	504 03	497 62	494 17
50000	530 20	526 62	523 44	520 73	518 31	516 18	514 31	507 78	504 25
51000	540 80	537 15	533 96	531 14	528 68	526 51	524 60	517 94	514 34
52000	551 40	547 68	544 47	541 56	539 04	536 83	534 88	528 09	524 42
53000	562 01	558 21	554 98	551 97	549 41	547 16	545 17	538 25	534 51
54000	572 61	568 75	565 38	562 39	559 78	557 48	555 46	548 40	544 59
55000	583 22	579 29	575 80	572 80	570 14	567 80	565 74	558 56	554 68
56000	593 82	589 81	586 21	583 22	580 51	578 13	576 03	568 71	564 76
57000	604 42	600 34	596 63	593 63	590 87	588 45	586 31	578 87	574 85
58000	615 03	610 88	607 24	604 05	601 24	598 77	596 60	589 02	584 93
59000	625 63	621 41	617 71	614 48	611 61	609 10	606 89	599 18	595 02
60000	636 23	631 94	628 18	624 87	621 97	619 42	617 17	609 33	605 10
61000	646 84	642 47	638 46	635 31	632 34	629 74	627 46	619 49	615 19
62000	657 44	653 00	648 80	645 70	642 71	640 07	637 74	629 65	625 27
63000	668 04	663 53	659 35	656 14	653 07	650 39	648 03	639 80	635 36
64000	678 65	674 07	670 08	666 53	663 44	660 71	658 32	649 96	645 44
65000	689 25	684 60	680 52	676 96	673 80	671 04	668 60	660 11	655 53
67000	713 76	710 03	706 70	703 88	699 72	696 68	694 32	685 80	680 74
69000	742 27	737 86	733 87	730 49	727 03	723 68	722 88	710 88	706 96
71000	765 78	763 88	760 05	756 81	753 68	751 33	749 47	740 73	731 17
73000	795 29	789 92	786 22	781 08	777 48	774 27	771 48	761 67	756 38
75000	848 31	842 98	837 87	833 18	829 30	825 99	822 90	812 44	806 80
77500	901 33	895 99	890 91	886 21	881 13	877 71	874 33	863 22	857 23
80000	954 35	947 11	943 96	939 25	933 96	930 13	925 76	914 00	907 65
82500	1007 37	1000 17	996 00	991 28	986 79	982 56	977 19	964 78	958 08
85000	1060 39	1053 23	1048 04	1041 43	1036 62	1032 38	1028 62	1015 55	1008 50

ESTIMATING HOME COSTS AND AFFORDABILITY

Choose a practical but comfortable home, and determine the square footage and cost based on the cost per square foot; then determine the monthly payment and the level of job necessary to support your payments.

Challenge Statement

Sometimes our dreams and needs are bigger than our income. With the cost of homes escalating every year, many people cannot afford homes for themselves and their families. This activity is designed to make you aware of the cost of housing and the income you will need to buy or build a home.

Objectives

- To estimate the cost of a house
- To determine the yearly income needed to be able to afford the house

Vocabulary

- Amortization tables
- Property insurance
- Square footage
- Landscaping
- Homeowner's insurance
- Mortgage payment
- Down payment

Equipment/Supplies

- Floor plans
- Checklist for Suburban Building Lot form
- Estimating House Costs form
- Determining the Mortgage Payment form
- Amortization tables
- Architect's scale
- Telephone and directory

Introduction

When you determine the cost of building a new home, you must consider the lot and the square footage of the home. The neighborhood you choose may have building restrictions that will affect the cost of your home. Some residential areas may require all brick or stone homes, while others may only require 50 percent brick front. Others may require a minimum of 2,500 square feet, while another may have no square footage restrictions. If you are building a home, the lot is an important consideration in the cost of your home.

After you have determined your building site, the cost, and the building restrictions, you are ready to design your home. The quality of workmanship, the equipment, and the finish will be a variable in the cost of your home. For example, if you want a bathtub with a jacuzzi, you will pay more than for a standard tub. If you want natural oak baseboards, you will pay considerably more than for painted pine baseboards.

Generally, your contractor or architect will give you a cost per square foot as a reference point, then add on any upgrades. A bank or mortgage company will take square footage into consideration in financing your home.

The total cost of your home with the homeowner's insurance and property taxes will determine your monthly payments. A mortgage company will not lend you more than they feel you can afford to repay. They will consider your job income and any other payments you make to determine your qualifications.

Procedure

1. Complete the Checklist for Suburban Building Lot form. If you know of a neighborhood where you would like to live, call the neighborhood, and get the minimum and maximum costs of the lots. Determine what you would like to spend. This will be added into the cost of your new home. If you do not have a preference for a particular area, use the cost you determined from the Checklist for Suburban Building Lot form to determine the total cost of your home.
2. Look through the house plans, and choose one you like. Transfer the sizes of the rooms from the floor plan to the Estimating House Costs form.
3. Compute the square footage of each room, and then calculate the total square footage of the home.
4. Using the total square footage, determine the total cost of the house.
5. Determine the minimum yearly income required to be able to afford the house. What type of job do you think you will need to be able to buy this home? What kind of training will that require?
6. Turn in your Checklist for Suburban Building Lot form and your Estimating House Costs form.

Evaluation

You will be graded on the neatness and accuracy of your Checklist for Suburban Building Lot, Estimating House Costs, and Determining the Mortgage Payment forms.

ADAPTING HOMES FOR PEOPLE WITH DISABILITIES

Essential Elements: 75.50(b): 2C, 2D, 3B, 4A, 4B, 5B, 6A, 6B, 6D, 6E, 7B, 8A, 8B
75.50(g): 1A, 1F, 2A-F

TAAS Objectives: Language Arts: RC 2, 4, 5, 6; WC 1-4
Mathematics: C 1-4; O 1-4; PS 1-4

Activity Overview
Through role-playing, your students will develop an understanding of the limitations of disabled people. They will use this understanding to design a home to accommodate the special needs of people with disabilities.

Challenge Statement
You are blind and fall over a chair someone moved in your home. You are deaf and do not hear the phone ring. You are mute and cannot call for help. These are only a few of the problems that people with special needs have.

The world is not set up for people with disabilities, but their homes can be. In order for a disabled person to be more independent, his or her home can be specially adapted and built with his or her needs in mind. Designers who have disabilities themselves, or are sympathetic to the needs of others, are best able to design homes to enable greater independence.

This activity is designed to give your students a hint of what it is like to have physical limitations, and help them see how people can work through the construction industry to help them. This will also give them a taste of custom building to meet client needs and expand their view of the construction industry.

Systems Model
Resources
Prequisite drafting skills and knowledge
Students as individuals with disabilities, architects, and designers
Instructor as resource and monitor
Standard drafting supplies and equipment

Processes
Role-playing
Brainstorming
Designing
Drafting
Reporting
Evaluating

Application
Imagining to problem solving
Brainstorming and teamwork to problem solving
Creative design to problem solving
Drafting skills to the design process
Adapting home construction to solutions for disabled individuals

Impact
Understanding of and empathy toward people with disabilities
Creative problem solving
Adapting home construction as solutions to problems

Interfacing with Other Disciplines

Language Arts: Students will role-play a physical limitation and record their observations in writing. From these observations, students will formulate solutions that will described through drafting.

Mathematics: Students will draft house plans using standard drafting practices, including dimensions.

Science: Students will gain insight into limitations caused by physical disabilities.

Social Studies: Students will learn how people help people through the construction industry by adapting the living environment to meet the needs of the individual.

Critical Thinking Skills Reinforced

Through role-playing, the students will experience some of the limitations of physically disabilities. They will have the opportunity to meet perceived needs through adapting a standard living environment. Once the students have formulated and composed solutions through drafting, they will analyze the drawings and make generalizations about specialized housing for those with disabilities.

Teaching Tips

1. This activity is an excellent follow-up activity for "Designing Devices to Help People with Disabilities." If you are following that activity, you should encourage your students to build in as many of their devices as appropriate to the construction of the special needs home. You will need to provide a tape recorder or "secretary" for the blind group during the brainstorming process.
2. Students will need prerequisite skills and knowledge of drafting. To save time, you may want to issue a standard house plan to the students to revise. This would put the focus on adapting rather than designing. Your more creative students would probably prefer to create a design from scratch. If you assign an extensive semester project, you may suggest that some of the students design a nursing home or facility for special needs people. If you have the equipment, encourage the students to use the computer to draw their plans.
3. During the evaluation process, point out to the students all the adaptations that have been made. Define *custom building* in terms of meeting the special needs of a client. These needs may be restrictive, as in the case of homes for disabled persons, or they can be expansive in terms of add-on for entertainment. Whatever the need, if it goes beyond a standard home, it becomes custom-built.

Instructional Strategy

- Open the class by setting up an environment for your students to simulate disabilities.
- Monitor students during their brainstorming exercise, and offer any assistance they may need in stimulating their imaginations to identify limitations in the home environment.
- Organize the tools and equipment for drawing the plans.
- Evaluate the students according to their creativity in design and accuracy of drawing.

Equipment/Supplies

1. Home Adaptation Sheet
2. Materials to simulate disabilities—blindfolds, plastic wrap to simulate partial sight, earplugs, long strips of fabric to bind arms or feet
3. Drafting tools and equipment

Evalution Key
Grade students on their cooperation and participation in the group. Their main grade will be on their creative adaptation and accuracy of their house plan.

Support Materials
1. Current construction and home design magazines and journals
2. Current textbooks

Home Adaptation Sheet

Name_____ Disability_____

Which two rooms provide the most difficulty for you?

1._____

2._____

What limitations do you find in room 1?

_____

_____

_____

_____

What could you design into the room that would make it more comfortable and useful to you?

_____

_____

_____

_____

_____

What limitations do you find in room 2?

_____

_____

_____

_____

_____

What could you design into the room that would make it more comfortable and useful to you?

_____

_____

_____

_____

Although you are only identifying two rooms on this sheet, you can, and should, make changes in other rooms if you feel they would be helpful.

ADAPTING HOMES FOR PEOPLE WITH DISABILITIES

Through role-playing, develop an understanding of the limitations of disabled people, and design a home to accommodate special needs.

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You are blind and fall over a chair someone moved in your home. You are deaf and do not hear the phone ring. You are mute and cannot call for help. These are only a few of the problems that people with special needs have.

The world is not set up for people with disabilities, but their homes can be. In order for a disabled person to be more independent, his or her home can be specially adapted and built with his/her needs in mind. Designers who have disabilities themselves, or are sympathetic to the needs of others, are best able to design homes to enable greater independence.

Objectives
- To understand some of the limitations of those with disabilities
- To adapt the design of a home to the needs of individuals with disabilities
- To understand the advantage of custom-designed and custom-built homes

Vocabulary/Concepts Reinforced
- Custom homes
- Standard designs
- Designer
- Architect
- Builder

Equipment/Supplies
- Standard drafting supplies
- Materials to simulate disabilities—blindfolds, plastic wrap to simulate partial sight, earplugs, long strips of fabric to secure feet

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Introduction
Many people with special needs want to be independent. Architects and designers can build homes to accommodate uncommon needs. They must recognize the limitations and obstacles that the average home presents for some people. Once they identify the problems, they can begin to formulate and design solutions.

Some questions architects might ask are:
a. How wide must a doorway be for a wheelchair to pass through easily?
b. How wide should a hallway be for a wheelchair to turn around?
c. How high should cabinets be for someone in a wheelchair?
d. How could someone who is deaf know whether the phone is ringing or someone is at the door?
e. What audible signal do we respond to in our homes?

To determine the adaptations necessary in a custom home, the architect or designer should spend a great deal of time with his/her client and present his/her ideas for approval.

Often the client may not be disabled him/herself, but may be providing housing for a family member or may be providing housing for a large number of disabled people in a group setting. Nursing homes are an example of such a situation. Although not all elderly people are disabled, many experience physical limitations that increase in intensity as time goes on.

New concepts in care for the elderly, disabled, and mentally retarded are emerging every day. Designers and architects and builders are a large part of the change. The best professionals in the construction industry are those who are attuned to the needs of all their clients.

Procedure

1. Draw a disability out of the box. For the next two or three class periods, you will role-play your disability to develop an understanding of special needs. Follow the directions to help you simulate your challenges.
   If you draw the card:
   a. *Visually impaired:* tie a blindfold around your eyes.
   b. *Partially sighted:* wrap two layers of plastic wrap around your eyes.
   c. *Hearing impaired:* use earplugs *and* the ear protectors from the lab, if available.
   d. *Mobility impaired:* tie a cloth around your feet and knees to remind you not to walk.

   Simulate your disability now.
2. Get into a group with your classmates with the same challenge. You may need help moving into groups. In your groups, brainstorm the problems you think people with your disability have in living independently in their homes. Imagine yourself going though your home to do a simple task. What are your limitations with your disability? What could actually be built into your home that would help you? Which rooms present the greatest challenge?
3. Record your limitations and possible solutions. The visually impaired group may need a tape recorder to record their observations for now.
4. Remove your limitations—your simulation props. Fill out the Home Adaptation Sheet.
5. Work independently to design and draw a simple two bedroom, one bath home with the adaptations you think would help someone be more independent. If you participated in the activity, "Designing Devices to Help People with Disabilities," determine how you could incorporate some of the helpful devices into your home. You could use not only the ones your group designed, but also any that were designed from all the classes. Your drawings should meet the standards your teacher assigns for this activity.
6. Meet with your group to compare the house plans you have designed. Choose two or three plans from the group to present to the rest of the class. If you have the appropriate computer software, redraw the houses using the computer.
7. Present the plans to the class by explaining the limitations and the adaptations you have made to provide more independent living.
8. Review all the plans. Talk with members of the different groups about the challenges they see people have with their role-play disability.

Evaluation
You will be graded on your cooperation and participation in your group. Your main grade will be for the creative adaption and accuracy of your house plan. Carefully follow the standards your teacher laid out for your drawing.

LIVING IN OUTER SPACE

Essential Elements:	75.50(b): 1A, 2C, 2D, 3A, 4A, 4B, 5A, 5B, 6A-E, 7A, 7B, 8A, 8B 75.50(g): 1A-I, 2A, 2C-I
TAAS Objectives:	Language Arts: RC 1-6; WC 1-4 Mathematics: C 1-4; O 1-4; PS 1-4

Activity Overview
Your students will learn about the environment of outer space and adapt a living environment that will allow them to eat, sleep, exercise, and work in outer space.

Challenge Statement
You feel a little lightheaded—in fact, so light, you are floating. Your juice won't pour but floats in a ball. Your pencil won't stay on the desk. Welcome to outer space, the world of weightlessness—zero gravity.

Astronauts are going into space and living for extended periods of time to do research, experiments, and eventually to build a space station. Without gravity or a supply of oxygen, water, and energy, a number of adaptations must be made in the living environment for them to function and exist.

Can your students design a living, working, and exercise area that they could live in, in outer space?

This activity is about much more than living in outer space. It is an exercise in adapting a living environment to meet the needs of an unusual clientele. It encourages your students to think beyond normal design and construction demands.

Systems Model
Resources
Students as research and development engineers, designers, astronauts, and evaluators
Instructor as resource person, monitor, and evaluator
Reference materials
Drafting supplies and equipment

Processes
Teamwork
Imagining the living conditions in outer space
Researching the effects of zero gravity, oxygen sources, energy sources, and water purification
Brainstorming design solutions
Cooperative teaching activity limitations and solutions
Compiling activity solutions to design a space station

Application
Science principles to the environmental conditions in outer space
Mathematical principles to dimensions for each activity area
Social principles of working and living together over extended periods of time

Technological principles of design, drafting, and construction
Communication to brainstorming and creative problem solving

Impact
The development of outer space
Working and living together in an alien environment
The application of science, math, and social skills
Using technology to solve problems
Career choices

Interfacing with Other Disciplines

Language Arts: Students will research information on the conditions in outer space, brainstorm solutions, and record their results in writing.

Mathematics: Students will realize the significance of spatial arrangements required for activities and living arrangements. They will draw floor plans and include dimensions.

Science: Students will learn about the environment in outer space including zero gravity, the lack of oxygen and water, and the lack of familiar energy sources. They will find solutions to provide a space station where people can live.

Social Studies: Students will learn about adapting living conditions to live in an alien environment. They will understand the motive for researching and developing outer space.

Teaching Tips

1. Several weeks before the activity begins, call or write NASA for information for your students.
2. In the first activity grouping, your students may need to research the effects of conditions in space. You could allow one person from each group to go to the library or provide books for your students to use in the classroom. By changing groups to form a new design group, you provide a cooperative teaching situation. Be sure each group has each activity represented so they will get a complete picture of the space station. Allow them freedom in their design process. Help them to realize the restrictions of a space environment.
3. In the evaluation, point out the special needs that are met through custom designing each area. Emphasize the necessity to distinguish the lifestyle and special needs of each client for architects, designers, and contractor.

Instructional Strategy

- Through cooperative teaching, encourage your students' creative thinking.
- Monitor their designs, and set the standards for their drawings.
- Close the activity by evaluating the utility of each space station and emphasizing the need for making adaptations for the special needs of each client.

Equipment/Supplies

1. Computer/CAD if available
2. Drafting supplies

Evaluation Key

Students should be evaluated on their cooperation and participation, their brainstorming sheets, and their drawings.

Support Materials
NASA Resource Centers
Attn: Teacher Resource Center
Mail Stop: 204-7
Moffet Field, CA 94035
(415)694-6077

1. Bernhardt, L. J., and McHaney, L. *Space Simulation.* Albany, N.Y.: Delmar, 1992.
2. Fales, J., et al. *Technology Today and Tomorrow.* Mission Hills, Calif.: Glencoe, 1992.
3. Hacker, M., and Barden, R. *Technology in Your World.* Albany, N.Y.: Delmar, 1992.
4. Komacek, S. *Production Technology.* Albany, N.Y.: Delmar, 1992.

Modifications for Handicapped, Disadvantaged, and LEP Students
Because your students will be working in a group setting, there is no need for additional assistance beyond the allowances you would normally make.

Name_____

Brainstorming Worksheet for Living in Outer Space

The concern of my group is (circle one):

Sleeping Eating Storage and Personal Hygiene
Working Exercise and Recreation

Does each person need his own space for this activity, or will they use the space one at a time?

_____

How much room will it take for this activity? Take several measurements and get an average.

_____

What are the limitations in your environment that require you to make adjustments?

1. _____
2. _____
3. _____
4. _____

What will you design for each limitation to make the activity possible?

For #1

_____

For #2

_____

For #3

_____

For #4

_____

Will any of these solutions be freestanding, or will they be built into the structure of the module?

*For #1*_____

_____

*For #2*_____

_____

*For #3*_____

_____

*For #4*_____

_____

LIVING IN OUTER SPACE

Learn about the environment of outer space, and design a space station that will allow you to eat, sleep, exercise, and work in outer space.

Challenge Statement
You feel a little light headed, in fact so light you are floating. Your juice won't pour but floats in a ball. Your pencil won't stay on the desk. Welcome to outer space, the world of weightlessness—*zero gravity*.

Astronauts are going into space and living for extended periods of time to do research, experiments, and eventually to build a space station. Without gravity or a supply of oxygen, water and energy, a number of adaptations must be made in the living environment for them to function and exist.

Can you design a living and working area that you could live in, in outer space?

Objectives
- To know the environmental conditions in outer space
- To understand the impact of living and working in an environment with no gravity, water, oxygen or energy source
- To understand the challenge of designing a comfortable living environment for astronauts
- To learn to adjust construction designs and techniques to the need of the situation
- To realize that through teamwork and problem solving, solutions can be found

Vocabulary/Concepts Reinforced
- Zero gravity
- Astronauts' habitat
- Cargo bay
- Environmental Control and Life Support System (ECLSS)
- Photovoltaic panels
- Pressurized cabins
- Ilmenite

Equipment/Supplies
- Computer/CAD if available
- Reference materials
- Drafting supplies

Introduction
The lack of water, energy, oxygen, and gravity provides a totally different living environment than we are used to. In order to take advantage of this atmosphere (or lack of it!), we must adapt our living conditions in order to live in outer space for extended periods of time. The environment will not adapt to us!

With the advances we have made in technology in the last 40 years, we are able to take advantage of the opportunities that being in orbit offers. We will manufacture new products for industry, medicine, and communications. We are only beginning to understand the potential of a weightless environment.

In order to take advantage of these opportunities, we will need to build a space station where people can live and work.

Procedure

1. Your teacher will divide the class into five groups. Each group will be responsible for answering the brainstorming worksheet and drawing a number of solutions for your living in space activity.
   The activities and the type of questions you need to ask are:
   Group 1: *Eating*—Where will you get energy to cook and refrigerate your food? Where would you put your spoon after you stirred your tea? Would you stir your tea?
   Group 2: *Sleeping*—Will you lie down? Will you cover up?
   Group 3: *Storage and personal hygiene*—Will you hang your clothes in a closet? How will you shower? Where will the water come from day after day? How will you heat the water?
   Group 4: *Exercise and recreation*—If your bones and muscles deteriorate much more quickly in zero gravity, will you lift weights to keep in shape? If you throw a ball, where will it go?
   Group 5: *Working*—Where would you put your paper and pencil? Would you have paper? Will you sit down to work? What kind of work would you do?

   You will need to determine the amount of room to allow for each activity area. Take several measurements, then take an average of the space requirements.

   After you have completed the worksheet, use that information to design the areas for your activity. Draw your solutions according to the standards your teacher sets. Include dimensions with your drawings. Use a CAD system if it is available. Design more than one solution.

   Each person in the group will need a completed brainstorming sheet and a set of the drawings.
2. Now you will divide into new groups. One person from each activity group will regroup into a new "space station design group." For instance, each group will have one person from the eating activity group, one from the sleeping activity group, one from the personal hygiene activity group, one from the exercise group, and one from the work group. You may need to have more than one represented from each activity group, if there were not the same number in each group. It is important that each activity group be represented in the new design group.
   In your new group, you will design a total space station. First, take time to share the brainstorming sheets and the drawings for each activity. This will allow you to get an overall idea of the challenges and possible solutions in each area. Listen carefully. You should take notes and jot down any ideas you get during this time.
3. Compile this information to determine the needs for a total living space station. How will you combine all the activities in one module? Are our homes a living module? What is similar, and what is different?
   Sketch some possible designs in the form of a floor plan. Review all the plans and vote on one which you will draw in detail.
4. Draw your final plan according to the standards your teacher sets. Include a floor plan with dimensions and a drawing or sketch of each wall view.
5. Present your group's space station design to the class. Evaluate each design for comfort and function. Does the plan meet the needs of the people? Is it comfortable? Does it provide privacy and a place to socialize?

Evaluation
As in any work situation, you will be graded on your cooperation and participation. You will also be graded on the brainstorming sheet and the drawings from your group.

BUILDING A SPACE STATION

Essential Elements:	75.50(b): 1A, 2C, 2D, 3A, 4A, 4B, 5A, 5B, 6A, 6B, 6D, 6E, 7B, 8A, 8B 75.50(g): 1A-D, 1F, 1G, 1I, 2A-I
TAAS Objectives:	Language Arts: RC 1-5 Mathematics: C 1-4; O 1-4; PS 1-4

Activity Overview
Your students will become aware of the limitations and adaptations necessary to construct a structure in outer space.

Challenge Statement
You have a new client who wants you to build a home. You really want the business, but you have a problem; they want it built in outer space.

Systems Model
Resources
The students as learners, designers, and builders
The instructor as resource person, monitor, and moderator
The supplies and equipment necessary to build the structure

Processes
Learning new concepts and vocabulary
Designing deployable and erectable structures
Teamwork
Constructing a space station
Evaluating the space station
Comparing skills and training of construction workers

Application
Mathematics knowledge and skills to design and construction
Science concepts to work
Technology knowledge and skills to space station construction

Impact
Construction careers
Living in outer space
Problem solving through teamwork

Interfacing with Other Disciplines

Language Arts:	Students will learn new vocabulary terms and concepts. They will adapt a model to a written description.
Mathematics:	Students will use a designated scale to build parts of a model, then assemble the parts to make a space station.
Science:	Students will learn about the effects of an outer space environment.
Social Studies:	Students will learn about living in space.

Critical Thinking Skills Reinforced
Through the design and construction of a space station model, the students will demonstrate their understanding of the demands of living in outer space.

Teaching Tips
1. It would be beneficial to your students to complete Module 25, "Living in Outer Space," before they begin this one. It is not a prerequisite, but it is enhancing. It would be helpful to have a transparency of the illustration sheet to describe the layout of a space station to the students.
2. Give the students a clear description of the standards and the scale for their individual components. This will ensure that the individual units will fit together for the final part of the activity.

Instructional Strategy
- Open the class with a visual description of a space station.
- Help the students integrate the vocabulary and visual description to formulate their ideas about construction in space.
- Monitor and direct the students as they complete their group projects.
- Close the activity with an evaluation of the finished product and a discussion comparing the skills and training in both areas of construction.

Equipment/Supplies
1. Plastic straws
2. Paper clips or thin wire
3. Cardboard
4. Heavy paper
5. Aluminum foil
6. Plastic wrap
7. Frozen drink containers
8. Paper towel rolls
9. Glue
10. Scissors
11. Wire cutters

Evaluation Key
Evaluate students on their participation and cooperation in the groups.

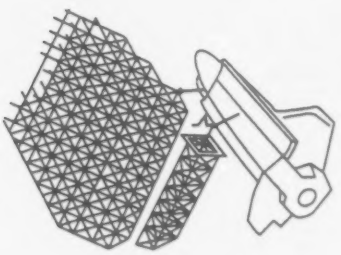
Support Materials
NASA Resource Centers
Attn: Teacher Resource Center
Mail Stop: 204-7
Moffet Field, CA 94035
(415) 694-6077

1. Bernhardt, L. J., and McHaney, L. *Space Simulation.* Albany, N.Y.: Delmar, 1992.
2. Fales, J., et al. *Technology Today and Tomorrow.* Mission Hills, Calif.: Glencoe, 1992.
3. Hacker, M., and Barden, R. *Technology in Your World.* Albany, N.Y.: Delmar, 1992.
4. Komacek, S. *Production Technology.* Albany, N.Y.: Delmar, 1992.

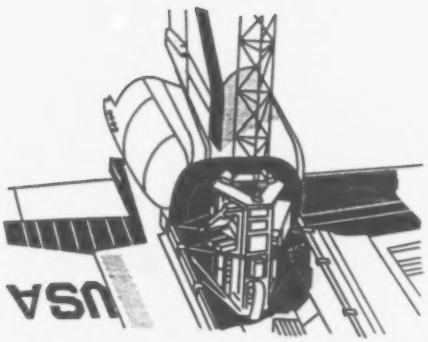
Modifications for Handicapped, Disadvantaged, and LEP Students
Because the students are working in groups, no modifications are necessary.

Space Construction Sheet

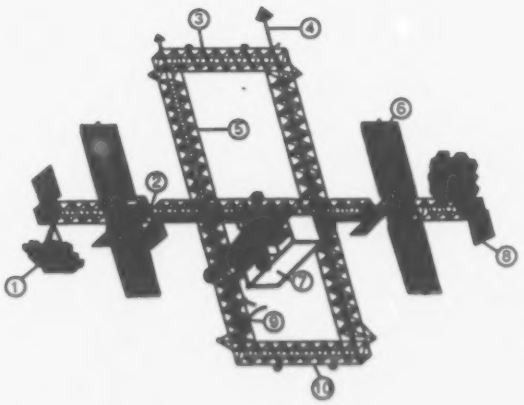
#1 Modular Antenna



#2 Automated Beam Builder



#3 Dual Keel Space Station Design



1. Solar Dynamic Power Unit
2. Alpha Joint
3. Upper Boom
4. Antenna
5. Vertical Keels
6. Photovoltaic Array
7. Servicing Facility
8. Radiator
9. Remote Manipulator
10. Lower Boom

BUILDING A SPACE STATION

Become aware of the limitations and adaptations necessary to construct a structure in outer space.

Challenge Statement
You have a new client who wants you to build a home. You really want the business, but you have a problem; they want it built in outer space.

Objectives
- To research the limitations involved with building structures in outer space
- To understand the tools and techniques currently being used in assembling a space station
- To learn to adapt techniques, tools, and materials to an unusual environment
- To understand the challenges facing development in space
- To realize that, through working together, every problem can be solved

Vocabulary/Concepts Reinforced
- Automated beam builder
- Microgravity
- Thermally stable materials
- Manned maneuvering units (MMU)
- Graphite-epoxy composite
- Deployables
- Erectables
- Shuttle cargo bay

Equipment/Supplies
- Plastic straws
- Paper clips or thin wire
- Cardboard
- Heavy paper
- Aluminum foil
- Plastic wrap
- Frozen drink containers
- Paper towel rolls
- Glue
- Scissors
- Wire cutters

Introduction
The fact that people will live and work in space is inevitable. The possibilities for developments in manufacturing, medicine, and science are unmeasurable at this point. In order to take advantage of the opportunities, people will work in orbit for extended periods of time to maintain equipment, do experiments, and record observations. Many tasks will be accomplished by robots and computers, but there are still many things only humans can do.

Living in space presents a challenge. We cannot fly the shuttle into space and unload 2x4s and float around with nail guns and extension cords. Totally new materials and methods of construction must be formulated to build a structure.

The materials will not have the same stresses associated with weight, but will strain from the extreme changes in temperature caused by solar radiation and shadows. The materials must be lightweight, thermally stable by not expanding and contracting with heat and cold, and very strong. A material that has been developed and tested that measures up to the test is graphite-epoxy composite, which is presently being used in the space shuttle and various sports equipment.

There are two types of structures that will be used in constructing space stations. One is called **deployable**, which means the structure will be made on earth, folded or collapsed, carried into orbit in the cargo bay of the shuttle, lined up in orbit, and formed into its proper structure. A simple example of this technique is the umbrella. A deployable cylinder about the size of a school bus could be unfolded into a giant antenna 2 acres in size in about an hour. See the illustration sheet.

Another structure is the **erectable** structure. In this case, the form is partially built but must be completed in orbit. This will require assembly by humans or robots and will require several shuttle trips back to earth to transport sections of the structure. A construction site will have to be built to allow the workers time to work, and a place to live, during the shuttle trips.

To build large structures on site, an automated beam builder has been designed. This equipment will be located at the end of the shuttle's cargo bay. Materials would be fed into the beam builder which would heat, shape, and weld the materials into triangular beams that could be cut into any length for construction. This saves hours and protects workers from dangerous tasks in a dangerous environment. See the illustrations.

Weightlessness creates a number of challenges. For example, when you turn a bolt, *you* turn with it. The cordless power drill was initially invented for this purpose. Latches that snap firmly shut are being used rather than traditional fastening devices because anything that is dropped or laid down floats away. MMUs, manned maneuvering units, were developed to allow the astronauts to move from one work station to the next. Movement through outer space is very similar to movement under water. The MMU jetpack makes movement much quicker and more accurate.

NASA has developed a set of requirements for the first space station. Besides living quarters for workers, the space station will have a facility for research and development, and a station to provide servicing for satellites. The facility will be expandable for the addition of special laboratories and increased living quarters.

Procedure

1. Carefully read the "Introduction." Review the vocabulary words, and study the illustrations to help you understand the different types of structures and techniques.
2. Decide if you would like to construct a deployable or an erectable structure as part of the space station. Sketch the structure according to the standards your teacher defines. Describe how it would be used in the space station.
3. Construct your structure using the materials your teacher provides. Your teacher will tell you the standards and scale to use for your structure. Review all the structural components for ideas for the next part of this activity. After you are assigned to your group, decide if you can use any of these components to build the assigned structural unit.
4. Your instructor will divide the class into groups to build an entire space station. Once all the groups have completed their assigned component, one member from each group will combine the parts to complete the space station. Use the scale your teacher sets.
   The groups are:
   Group 1, Living Quarters: You will construct a model of the living quarters from the exterior view. If you participated in the activity, "Living in Outer

Space," use the dimensions of those living quarters. If not, use the dimensions of a large motor home.

Group 2, Research and Development Station: You will build a research and development station from an exterior view. This station will house a number of robots and computers. Humans will come in and out to bring materials, make observations, maintain equipment, and record data, but the main purpose is for equipment use.

Group 3, Satellite Maintenance Station: You will build a structure to house the equipment and supplies to maintain satellites. There must be ample space to repair dysfunctional equipment.

Group 4, Photovoltaic Power Units: You will build four photovoltaic panels to collect energy for the power station.

Group 5, Triangular Shaped Truss Beams: Your group will build the trussed beams that hold the structure together. You will need to determine the number of beams necessary to support all the individual components.

Group 6, Remote Manipulator Arm and Antenna: You will build both a robot arm and an antenna to attach to the beam trusses.

5. One member from each group will assemble the space station. While they work, participate in a discussion comparing the skills and training needed to work in construction with the skills and training needed to participate in construction in outer space.
6. Analyze the completed space station. How complete is the facility? Do you think it is adequate to provide a living environment? What would you add to improve the station?

Evaluation

You will be evaluated on your participation and cooperation while working with your groups. You will receive a class grade for the overall space station structure.

CAREERS IN CONSTRUCTION

Essential Elements: 75.50(b): 2A, 2B
75.50(g): 2D
TAAS Objectives: Language Arts: RC 1-3, 5; WC 6

Activity Overview

Students will study the *Occupational Outlook Handbook* to learn about construction-related careers. After reviewing the opportunities, they will determine which jobs would be most interesting to them as a career.

Challenge Statement

One of the most important choices your students will make is deciding on a career or job field. Because their job will take the greatest part of their time, it should be a job in which they have an interest and aptitude. The construction industry provides a large number of jobs and opportunities for those with a willingness to work. Construction workers include people who manage, build, and service construction projects.

Systems Model

Resources
Students as construction workers
Teacher as facilitator and employment counselor
Job Analysis Chart
Occupational Outlook Handbook
Job Interview Sheet
Other career references

Processes
Explanation of job titles
Researching careers
Recording information
Reporting career interests

Application
Long-term career choices
Construction industry

Impact
Career satisfaction

Interfacing with Other Disciplines

Language Arts: Students will take notes during lecture, fill in a chart, and report to the class orally.
Social Studies: Students will consider career choices to benefit themselves, their families, the community, and society.
Mathematics: Students will record information in chart form.

Critical Thinking Skills Reinforced
Students will draw conclusions about personal career choices after gathering information and analyzing various options. They will organize the information in chart form for quick analysis and prioritize their choices.

Teaching Tips
1. When presenting the job descriptions, have the students take notes for future reference.
2. Have enough *Occupational Outlook Handbooks* and other career information on hand so the students are not idle while waiting for reference materials.
3. Encourage each of the students to give the oral report. You can tell them that this will help them become comfortable speaking before people. If they are ever in a management position, they may be called on to do this.
4. You can enhance the unit by having speakers or videos from different construction careers.
5. Emphasize the importance of making wise career choices and the option of changing jobs if the first choice does not work out.
6. Grade the students on the Job Analysis Chart and their reports.

Instructional Strategy
- Present the career choices through a lecture as the students take notes. Help the students understand the relationship between all the areas.
- Assist the students in analyzing their charts to make their job choices. Bring them to a conclusion regarding the relationship between wages and training.
- As the students present their choices, question them about the reason for making their decisions.

Equipment/Supplies
1. Job Analysis Chart
2. *Occupational Outlook Handbook*
3. Job Interview Sheet
4. Other career references

Evaluation Key
Evaluate students on how neatly and accurately they have completed the Job Analysis Chart, how well each student reported to the class on his or her job choices, and completion of the Job Interview Sheet for extra credit.

Modifications for Handicapped, Disadvantaged, and LEP Students
Some students may need help using the reference materials. Students with disabilities can evaluate their job choices in relation to their abilities, as all the students will. They may need help understanding any requirements of the job that they may not be able to meet.

Support Materials
1. Harms, H.R., and Kroon, D.K. *Production Systems Technology*. Peoria, Ill: Glencoe, 1992.
2. Ritz, J.M., et al. *Exploring Production Systems*. Albany, N.Y.: Delmar, 1990.

Job Analysis Chart

	Job Title	Training	Wages	Work Difficulty	Future	Advantages/ Disadvantages
	Example: Molder	OJT	$3.00-$6.00/hr	Hard, dirty	Fair	Good pay Hard work
	Example: Bricklayer	OJT TS	$10-$11/hr	Hard, dirty	Good	Good pay
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

On-the-job training	__OJT	Give approx. wage	Hard	Poor	List
Trade school	__TS		Easy	Fair	
College	__C		Hot	Good	
Other	__O		Dirty	Excellent	
			Clean		203
			Dangerous		

Job Interview Sheet

1. Name of person interviewed? (optional)
2. Where employed?
3. Why have you chosen this job?
4. Do you like your work? Yes _____ No _____
5. Is your work difficult? Yes _____ No _____

   If yes, how?

6. Does your job involve any of the following:

   Forming
   Separating
   Conditioning
   Combining

7. How much do you earn in wages or salary? (optional)
8. What advice would you give a student in relation to future employment?

9. Do you have fringe benefits? Yes_____ No _____

   If yes, what are they?

10. What education and training is required for your job?

CAREERS IN CONSTRUCTION

Learn about construction-related careers to determine which jobs would be most interesting to you.

Challenge Statement

One of the most important choices you will make is deciding on a career or job field. Because your job will take the greatest part of your time, it should be a job in which you have an interest and aptitude. The construction industry provides a large number of jobs and opportunities for those with a willingness to work. Construction workers include people who manage, build, and service construction projects.

Objectives

- To know at least eight occupations related to construction
- To understand the meaning of each occupation
- To understand the working conditions associated with each occupation
- To indentify two or three job choices you would make and determine the training necessary to secure a job

Vocabulary/Concepts Reinforced

- See the list of construction careers.

Equipment/Supplies

- Job Analysis Chart
- *Occupational Outlook Handbook*
- Job Interview Sheet
- Other career references

Introduction

This activity is designed to help you realize all the opportunities available in the construction industry. Once you are aware of the opportunities, you can choose your specific area of interest to make a job determination.

Procedure

1. Listen to the description of construction careers from your teacher. Take notes of the information.
2. Choose eight of the careers from the list of careers. Using the *Occupational Outlook Handbook*, complete the Job Analysis Chart.
3. Choose two or three of the careers that you would enjoy, prioritize them, and report your choices to the class. Explain the advantages and disadvantages as you see them.
4. Turn in your Job Interview Sheet for extra credit.

Evaluation

Your evaluation will include how neatly and accurately you complete the Job Analysis Chart, how well you report to the class on your job choices, and completion of the Job Interview Sheet for extra credit.

Construction-Related Careers

Bricklayer and stonemason
Cabinetmaker
Carpenter
Carpet installer
Concrete mason and terrazzo worker
Drywall worker and lather
Electrician
Glazier
Insulation worker
Painter and paperhanger
Plasterer
Plumber and pipefitter
Roofer
Roustabout
Sheetmetal worker
Structural and reinforcing metal worker
Tilesetter

STEP-BY-STEP PROBLEM SOLVING

Essential Elements: 75.50(b): 1A, 2C, 3A, 6A, 6D
75.50(g): Depending on the topic areas, all EE's may be met

TAAS Objectives: Language Arts: RC 1-6; WC 1-4
Mathematics: PS 2, 4

Activity Overview

In this activity, students will study the proper way to solve problems and work with a partner to identify a problem and a realistic solution.

Challenge Statement

Poor grades, job burnout, old car and no money, poor production from assembly line workers: these are all problems that need solutions. Unfortunately, problems are a part of life. No one escapes them. We have personal challenges, and businesses have business challenges. The most important thing about problems is not the problem itself, but how well you face the challenge.

When a problem exists, logical steps should be taken to solve it. Doing this will avoid confusion so that problems can be solved quickly. If you panic or get frustrated, the problem will continue and may even get worse.

This exercise is designed to teach your students a step-by-step way to face all challenges whether personally or in business.

Systems Model

Resources
Students as problem solvers and evaluators
Teacher as discussion leader and monitor
Suggested Topics for problem-solving sheet
Model for problem-solving sheet

Processes
Study of the problem-solving model
Identifying a problem
Developing and analyzing possible solutions

Application
Problem-solving techniques to a real-life problem

Impact
Personal challenges
Business challenges

Interfacing with Other Disciplines

Language Arts: Students will learn new words and concepts while finding the solutions to problems in a sequential manner.

Mathematics: Students can compare mathematical problem-solving techniques, using numbers, with the technology model on problem solving. The technology teacher could inform the math department of this activity to emphasize problem solving at this time.

Science: Students can compare the scientific method with the technology model to understand that all areas use problem-solving processes.

Social Studies: Students will research and test solutions to problems that affect society.

Critical Thinking Skills Reinforced

Through a problem-solving model, students will define a problem, propose a number of solutions, analyze and prioritize solutions, and evaluate the chosen solution based on the feedback of the class.

Teaching Tips

1. Have a transparency of the Model for Problem Solving to explain in detail with the students. It would be helpful to follow through a practice problem with them before they begin their activity.
2. In the reporting phase of the activity, remind the students to give only constructive ideas. Remind them that all solutions are good if they are carefully considered. People with different opinions will have different solutions.

Instructional Strategy

- Open the class with a lecture and discussion on the Model for Problem Solving.
- Assist your students in following the sequential steps of the model.
- Provide feedback, and lead the class in an evaluation of the chosen solutions from each group.
- Close the class with a review of the process.

Evaluation Key

Students will be evaluated on their problem-solving reports and on the test.

Test Answer Key:

1. It helps solve problems more efficiently.
   It causes people to look at several possible solutions and choose the best one.
2. (Any five): identify the problem; gather pertinent information; define the problem; develop solution models; analyze solution models; implement solution; monitor for problems.
3. a. limitations
   b. constants
   c. variables
4. a. use of drawings and sketches
   b. use of mock-ups—three-dimensional models
5. The problem is recycled; it follows a feedback loop on the problem-solving model.
6. how well the solution works when implemented and evaluated
7. The "process of producing" something often involves the "producer" solving problems. Examples are product design, process design, plant layout, personnel management, storage of materials, material handling, sales, marketing, etc.

Support Materials

1. Jones, R. E., and Wilson, K. A. *Problem-Solving Activities for Technology Education.* Austin: Extension Instruction and Materials Center, The University of Texas at Austin, 1991.
2. Landers, J. M. *Construction.* South Holland, Ill.: Goodheart-Willcox, 1976.
3. Wagner, W. H. *Modern Industry.* American Technical Society, 1975.
4. Wright, R. T., and Jensen, T. R. *Manufacturing.* South Holland, Ill.: Goodheart-Willcox, 1976.

Modifications for Handicapped, Disadvantaged, and LEP Students

Additional time and explanation may be necessary for some students. Working with a partner will allow the student assistance in the process.

Name_____

Problem-Solving Test

1. Why is a problem-solving model used?

2. List five major parts of the problem-solving model.

   a.

   b.

   c.

   d.

   e.

3. What are three types of factors which need to be studied?

   a.

   b.

   c.

4. What are two ways solution models might be developed?

   a.

   b.

5. What happens if proposed solution models are not acceptable?

6. What determines if the solution will be accepted on a long-term basis?

7. Why would a problem-solving model be useful in production?

Suggested Topics for Problem Solving

1. Moving people and goods over land

2. Moving people and goods through the air

3. Moving people and goods in water

4. Mass transit of people

5. Communication over long distances

6. Heating the places where people live

7. Producing food

8. Recycling

9. Adapting to the hole in the ozone layer

10. Automotive pollution

11. Affordable housing for families

12. Parking in crowded cities

13. Affordable automobiles

STEP-BY-STEP PROBLEM SOLVING

Study the proper way to solve problems, and work with a partner to identify a problem and find a realistic solution.

Challenge Statement

Poor grades, job burnout, old car and no money, poor production from assembly line workers: these are all problems that need solutions. Unfortunately, problems are a part of life. No one escapes them. We have personal challenges, and businesses have business challenges. The most important thing about problems is not the problem itself, but how well you face the challenge.

When a problem exists, logical steps should be taken to solve it. Doing this will avoid confusion so that problems can be solved quickly. If you panic or get frustrated, the problem will continue and may even get worse.

This exercise is designed to teach you a step-by-step way to face all challenges whether they are personal or business challenges.

Objectives

- To know the role of the problem-solving technique to use personally and/or in production
- To apply the problem-solving model to a real-life situation
- To understand that the critical issue in problems is not the problem, but how it is handled

Vocabulary/Concepts Reinforced

- Model
- Problem-solving model
- Symbol
- Oblate
- Trapezoid
- Rectangle
- Diamond
- Input
- Output
- Decision point
- Feedback loop
- Arrows
- Limitations
- Constants
- Variables
- Implement

Introduction

The word *model* has several meanings. A model airplane is a scaled-down version of the real thing. A problem-solving model is a plan for solving problems. Refer to the Model for Problem Solving as you read this Introduction.

This plan is drawn in the form of a flowchart. Various shapes are used in the flowchart. Each shape is a symbol, and represents a particular kind of action.

This is an oblate. It shows the beginning or the end of a problem.

The trapezoid is used to show where information is fed into or out of the system.

A rectangle is used to tell what functions or actions must take place.

A diamond indicates decision points. Usually a question is asked at this point. Lines that feed back to an earlier step are called "feedback loops."

Arrows show the flow of the system.

Let's look at the problem-solving model. The starting point is to identify the problem

(A) Finding out what is already known about the problem may give clues to possible solutions (B). (C) **Limitations** are factors that restrict in some way. Limitations such as costs may set boundaries on possible solutions for the problem. (D) **Constants** are factors that stay the same. **Constants** may be fixed by nature or they may be controlled as part of an experiment. The (E) **variable** is the factor that is made to change. After classifying information, it is possible to define the problem in detail. (G) Solution models are ideas for solving the problem. Solution models could be drawings or physical models. Several solutions are suggested. (H and I) Ideas are tested to see which is the best solution. Physical models are built and tested. If the solution is good enough, it will be implemented. (J) The solution is accepted. (K) Continue observation to see how well it works and to see if any new problems develop. This helps determine the range and limits of the solution. (L) If feedback is positive, the solution is accepted. If feedback is negative, the problem-solver must recycle through the earlier steps of the model. (M) Eventually, positive results should be achieved.

Procedure

1. Listen carefully as you read through the Introduction. Follow the Model for Problem Solving sheet as each item is explained. This will help you with your part of the activity later. Ask questions if you do not understand.
2. You will work with a partner for this exercise. Choose one of the topics listed on the Suggested Topics for Problem Solving sheet, or if you cannot choose any of these, define one of your own. Have your instructor approve your topic. Remember, even though you get to choose a topic in this activity for problem solving, in real life we do not get to choose the problems we would like to solve. More often than not, our problems choose us!
   Now that you have selected a topic, identify the problem. Each of the topics can have more than one problem; you need to identify the one for which you will find a solution.
3. Apply the Model for Problem Solving to your problem. You may need to use reference materials to help you gather information (B) and analyze solutions (H). Record each step you take on a piece of notebook paper to be turned in for a grade. Once you determine your solution, you will implement it (J) by reporting it to the class. At that point, the class will give you feedback (L). You will then determine if you keep your solution (M) or choose another. If you choose another solution, you will report it as the problem solved (M).
4. When you and your partner complete your work, you will report the problem, the solution, and the reasons for your solution to the class. Some of the other groups may have defined similar problems and identified different solutions.
5. Turn in the completed work for a grade. Be sure both of your names are on the paper.

Evaluation
You will receive a grade on the problem and solution report you turn in and a grade on the problem-solving test.

THE WORK PROCESS

Essential Elements: 75.50(b): 1A, 2A-D
75.50(g): 1B, 2E
TAAS Objectives: Language Arts: RC 2, 4, 5, 6; WC 1-4

Activity Overview

Your students will role-play interviewing for a job through a personnel game. Afterwards, they will receive either a raise or a demotion through the draw of a card. They will fill out an evaluation sheet to identify the insight they have gathered through the game.

Challenge Statement

Often there are fewer jobs than people who need them. It is important that your students know how to interview for a job when they are competing for work in the marketplace. Once they have received a job, they must be responsible and capable enough to keep it. Employers cannot afford to keep incapable employees.

Systems Model

Resources
Students as personnel managers and job applicants
Teacher as facilitator
Personnel Cards for role playing
Evaluation Sheet for review and analysis

Processes
Discussion for gathering information
Role-playing for interviewing experience
Evaluation and discussion for analysis and application of learning

Application
Student job search
Student involvement in the work process
Responsibility to the workplace

Impact
Responsible employees in the workplace

Interfacing with Other Disciplines

Language Arts: Students will learn the meaning of new words and concepts. They will fill out an employment application and an evaluation sheet.
Social Studies: Students will become aware of personal responsibility in acquiring and maintaining a job.

Critical Thinking Skills Reinforced

Students will evaluate the outcome of the role-playing activity to draw conclusions about the work process. They will analyze their situations and apply the information drawn to their own career

goals. This will help them identify their own values, and the values in society, necessary to be successful in the workplace.

Teaching Tips

1. Cut out the Personnel Cards and the Promotion/Demotion Cards, and back the cards with cardboard before the unit begins. You can laminate the cards for continued use.
2. Review the information in the Introduction section on the student activity sheet. Explain the rules and the purpose of the game.
3. Select three or four "personnel managers." They should each choose a company name. Each personnel manager then writes his/her company name on a large card and sets up an interview station. The other students will draw a Personnel Card and fill out application forms based on that information. Have the personnel managers interview the students at their company interview stations. Students should try to play their roles as authentically as possible. The personnel managers must also choose a card and be interviewed.
4. Both parties must agree on job conditions, salaries, hours, etc. A contract is then filled out, and both parties sign it. All students must have signed contracts in their possession.
5. The concluding part of the Personnel Game involves the use of the Promotion/Demotion Cards. The employee draws one card. The personnel manager and the employee review the card. Both discuss whether a promotion, demotion, or "no change" is in order. Rewrite the original contract.
6. Review the Evaluation Sheet. Suggested discussion questions include: Did you get hired? How much did you get paid? What did you look for when you interviewed a person? Did you get fired or promoted? Discuss the outcome of several students, and draw conclusions about qualifications and characteristics of successful employees.
7. Students seem to have a lot of interest in this type of activity. Use a videocassette recorder if possible during the interviews.
8. Because of the free time most of the students have during the interviewing process, you may want to incorporate this exercise with another activity. Module 27, "Careers in Construction," or no. 13 in the Technology Activity Challenges would be an excellent overlapping activity.

Instructional Strategy

- Open the class by explaining the importance of the interviewing process in acquiring work.
- Expand the discussion by reviewing the information in the Introduction on the student activity.
- Facilitate the students in the learning activity through the interviewing process.
- Close the unit with an analysis of the process through the evaluation sheet and discussion.
- Help the students apply learning though application of the information to their own situation and personal job goals.

Equipment/Supplies

1. Personnel cards (24)
2. Promotion/demotion cards (12)
3. Application form and contract form

Modifications for Handicapped, Disadvantaged, and LEP Students

No modifications are necessary. Instruct personnel managers to be sensitive to any disabilities.

Evaluation Key

Evaluate participation in the Personnel Game and the degree of understanding of the process through the Evaluation Sheet. The test is available for an objective grade, if desired.

Test Answer Key

1. b, e, h
2. c, e
3. b, f, h
4. c, f, g
5. a, c, f, j

Application Form

Name _____
(Last) (First) (Middle)

Today's Date_____ Social Security No._____

Phone Number _____

Address _____
(City) (State)

_____

Employment Desired

Position _____

Part time or Full time_____ Salary desired_____

Date you can start_____ Are you employed now? Yes/No

Education

Where did you attend -

Grade School _____

High School_____

College_____

What % did you have to pay for your education per year _____

Date graduated _____

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Subjects studied _____

Subjects of special study or research work _____

_____

Activities (athletics, etc.) _____

_____

Former employers _____

_____

_____

_____

Salary received in last position _____

Position _____

Reason for leaving _____

_____

Physical Record

List any physical defects _____

_____

Were you ever injured - give details Yes/No _____

_____

_____

In case of emergency notify Name_____
Phone_____
Address_____

I authorize investigation of all statements contained in this application. I understand that misrepresentation or omission of facts called for is cause for dismissal. Further, I understand and agree that my employment is for no definite period and may, regardless of the date of payment of my wages and salary, be terminated at any time without any previous notice.

Date_____

Signature _____

(For the Personnel Manager - Job Applicate: Do not use this space)

Interviewed by _____

Date_____

Remarks_____

Neatness_____

Personality _____

Character_____

Ability_____

Hired for Department _____

Position_____

Salary_____

Will report _____

Approved Employment Manager _____ General Manager_____

Contract Form

Name of Corporation _____

Name of Agent _____

Job Contract _____

This job will last for _____ (months, year)

Years of Experience _____

This job requires 40 hours a week, 8 hours a day, 5 days a week.

(Additional Job Information) _____

_____

_____

_____

_____

_____

_____

(Name of Corporation) _____

_____

(Signature of Agent)

_____

(Signature of Officer Signing and Title)

Name_____

Evaluation Sheet

1. Did you get hired?_____
2. What traits helped you get the job?

_____
_____
_____
_____

3. Did your education help?_____
4. Would experience help?_____
5. What would have hurt you in your job search?

_____
_____
_____

6. What did the personnel managers look for when interviewing you?

_____
_____
_____
_____
_____

7. How much will you get paid?_____
8. After you chose a card, did you get fired or promoted?_____Why?

_____
_____
_____
_____
_____
_____
_____
_____

9. What could you do to get a better job?

_____
_____
_____
_____
_____

10. What are your personal job goals? (What do you want to be when you grow up?)

_____
_____

11. From what you learned in this unit, what could you do to help you be successful in your job choice?_____

_____
_____
_____
_____

Name_____

TEST
The Work Process

Directions: Darken the appropriate bubbles that indicate your choices.

1. Select three elements of the hiring process.
   - O a. budgeting
   - O b. recruiting
   - O c. classifying
   - O d. mailing
   - O e. selecting
   - O f. inspecting
   - O g. firing
   - O h. inducting
   - O i. dispatching
   - O j. conditioning

2. Select two types of training programs.
   - O a. achievement
   - O b. charter
   - O c. apprenticeship
   - O d. discrimination
   - O e. seminar
   - O f. appointment

3. Select three elements of the working system.
   - O a. spoken agreement
   - O b. economic rewards
   - O c. assumed agreement
   - O d. compromise
   - O e. negotiations
   - O f. physical working environment
   - O g. fringe benefits
   - O h. social working environment

4. Select three elements of the positioning system.
   - O a. monitoring
   - O b. smoothing
   - O c. demoting
   - O d. tracking
   - O e. leading
   - O f. advancing
   - O g. discharging
   - O h. leveling

5. Select four elements of the retiring process.
   - O a. awarding retirement benefits
   - O b. reassigning
   - O c. counseling
   - O d. assigning
   - O e. providing
   - O f. recognizing service
   - O g. job time
   - O h. leisure fundamentals
   - O i. phasing
   - O j. preretirement job engineering

Personnel Cards

Born: 12/25/53
Anamosa High School
Employer: Caterpiller Tractor Company
Equipment Mechanic
Married; 5 children
AA Degree, TCJC, 1971
Subjects: liberal arts
21 years' experience
Average pay: $8.00/hour
Hobbies: reading war stories
Presently employed
No injuries

Born: 2/4/66
Plum Vocational-Technical High School
Employer: Trader Vic's
Head Cook
Married; 4 children
Apprenticeship at Fondue School of the Gourmet; graduated, 1977
Studied nutrition
8 years' experience
Average pay: $4.50/hour
No time for hobbies
Position wanted: Pastry Worker
No handicaps or injuries

Born: 1960
Texas Technical High School
Unemployed
Computer Operator
Married; 2 children
College degree from UCLA, 1983
Computer science major
1 year experience
Salary: $33,000
Hobbies: ice skating
Employer was Univac Corporation; computer took over the operator's job
No handicaps or injuries

Born: 1957
High school dropout
Unemployed
Truck Driver
Married; 3 children
Kirkwood Driving School, special school for truckers
5 years' experience; can drive all kinds of trucks
Average pay: $5.50/hour
Hobbies: wine tasting
Employer was P.I.E.; lost driver's license
No handicaps or injuries

Personnel Cards

Born: 6/7/59
Houston Tech High School
Employer: Reddy Kilowatt Corporation
Machine Electrician
Not married
Graduated from Prairie View A&M University
Majored in electronics
2 years' experience
Average pay: $6.00/hour
Hobbies: ham radio
Want to do troubleshooting
Handicap: speech
Injuries: Nearly electrocuted

Born: 1925
Calmar Technical High School, 1942
Employer: Log Homes, Inc.
Construction Worker
Widower
Apprenticeship: woodworking and drafting
40 years' experience, hard worker
Average pay: $5.00/hour
Hobbies: building wood furniture
Bored with retirement
No handicaps
Injuries: Lost hand in power saw accident

Born: 6/24/69
Shannon Grade School
Dropped out of school: 8th grade
Unemployed: supported by parents
Assembly-line worker
Not married
No college
No experience; will learn fast
Average pay: $4.35/hour
Hobbies: fishing and cars
Previous employer: Fisher Govenor
Moved away from city
No handicaps or injuries

Born: 7/7/57
Burns Elementary School
Roosevelt High School
Employer: C.R. Crafts
Carpenter, Journeyman
Single
Technical subjects in high school
10 years' experience
Average pay: $7.00/hour
Spare time: tearing down old houses
Looking for better job opportunity
No handicaps or injuries

Personnel Cards

Born: 1/1/60
Private tutor (grade school)
Price Private School (high school)
Employer: Tri-state Corporation
Architect
Married; 3 children
UT Austin: B.S. in Architecture
Drawing & Math
2 years' experience, 1 year worked for a large corporation
Salary: $18,000/year
Hobbies: mountain climbing
Presently employed; always looking for growth opportunities
Handicap: 45% hearing loss

Born: 7/4/63
Central High School
Unemployed
Secretary
Married; 1 child
1 year college
Clerical skills
3 years' experience
Average pay: $5.00/hour
Hobbies: sewing, reading
Former employer: Texas Instruments
Reason for leaving: Plant layoff
No handicaps or injuries

Born: 1/6/60
Austin Elementary School
Lincoln Technical High School, 1979
Employer: Firestone
Not married
No college
6 years' experience; do any factory work
Average pay:. $4.25/hour
Hobbies: hang gliding
Want to broaden working experiences
No handicaps or injuries

Born: 7/28/30
Carpenter Grade School
No high school: dropped out in 7th grade
Unemployed
Single
7 years' experience; former worker in large industry; will work nights
Average pay: $4.75/hour
Hobbies: tackle football
Past employer: Denton High School
Janitor
Fired for sleeping on job
No handicaps of injuries

Personnel Cards

Born: 5/17/65
Johnson Elementary School
Robert E. Lee High School
Self-employed
Carpenter
Married; 2 children
No college
2 years' experience
Made $16,000 last year
Hobbies: remodel houses in spare time
Want steady work with vacation time
No handicaps or injuries

Born: 6/10/52
Tyler High School
TAMU: Degree with honors, civil engineering
Employer: City of San Antonio
City Engineer; Civil Engineer
Married; no children
10 years' experience
Salary: $35,000/year
Hobbies: sailing and fishing
Want to move to the area
Handicap: color-blind
No injuries

Born: 8/2/62
Jefferson High School
Southwest Texas State University, police criminology
Employer: Pinkerton's, Inc.
Security Guard
Married; no children
6 months' experience
Average pay: $6.50/hour
Hobbies: weight lifting & karate
Would like job with more responsibility
Handicap: hearing loss in one ear
No injuries

Born: 4/25/58
Crockett Technical High School
Employer: ABC Cab Company
Head Auto Mechanic
Married; 16 children
No college
9 years' experience
Average pay: $8.00/hour
Hobbies: enjoying the children—when there is time
Need more money—too many mouths to feed
Injury: Vietnam war injury; slight limp in right leg
No handicaps

Personnel Cards

Born: 12/1/59
Bowie High School
Presently unemployed
Construction Foreman
Married; no children
Hawkeye Tech: 2 years
Welding
Alaska Pipeline for 4 years
Average pay: $17.00/hour
Hobbies: needlepoint, football
Had to move to a warmer climate
No handicaps or injuries

Born: 9/5/52
Pines City High School
Graduate of Ryder Truck School
Self-employed
Truck Driver
Married; 2 boys
15 years' experience; can drive anything but semis; own a 10-ton truck
Average charge: $0.09/mile
Hobbies: no time
Want $0.15/mile
Have been picked up twice for speeding
No handicaps or injuries

Born: 5/12/58
El Paso High School
Texas Trade School at El Paso, specialized in apartment systems
Unemployed
Plumber
Married; 2 children
9 years' experience
Average pay: $7.70/hour
Hobbies: build hot rods
Worked 9 years for Ace Plumbing until they went out of business
No handicaps or injuries

Born: 6/2/50
Midland Technical High School
Specialized in air conditioning and heating in high school
No college
Unemployed
Plumber
Married; 5 children
5 years' experience
Average pay: $7.00/hour
Hobbies: playing poker
Fired for missing too many days of work
No handicaps or injuries

Personnel Cards

Born: 10/15/48
Waco High School
Graduated from North Texas State University, majored in business education
Employer: Trugg Transfer Co.
Superintendent
Married; 5 children
15 years' experience
Salary: $20,000/year
Hobbies: chess
Want job with more challenge
No injuries or handicaps

Born: 3/19/50
Sam Houston High School
Degree from Texas Southern University, aerospace engineering
Employer: Totem Company
Barge Worker on the Great Lakes
Married; no children
11 years' experience
Average pay: $6.00/hour
Hobbies: the latest dance craze
Would like to get back to engineering
Handicap: blind in left eye
No injuries

Born: 11/13/50
Waco Technical High School
Took lots of industrial technology classes in high school
No college
Employer: Collins/Rockwell, Inc.
Tool and Die Maker
Married; 1 child
15 years' experience
Average pay: $14.00/hour
Hobbies: boating, skiing, and fishing
Need more time off
No handicaps or injuries

Born: 7/24/60
JFK High School
Graduated from the University of Texas at Tyler, business administration major concentrating in finance
Employer: John Deere
Quality Control Inspector
Married; 2 children
12 years' experience
Salary: $14,000/year
Hobbies: crossword puzzles
Want more responsibilities, head department
No handicaps or injuries

Promotion/Demotion Cards

Doesn't follow the rules. Has a few accidents on the job. Has trouble keeping up, doesn't get along with boss but is doing good work. Uses head to figure out problems.

Has been working for 1 year and has saved $15,000 dollars for the company. Been in a few fights. Is always prompt for work; when people are doing nothing he gets them moving.

Very good worker. Saved the company some money by not wasting materials that might have cost an extra $100 per week. Recently married.

Has been coming to work late because of family problems but does a good job. Also gets along well with the other workers.

Does a very good job except when the boss watches. Works late, not for the money but to help the company.

Comes to work late, calls in sick and then goes out and has a good time. Doesn't get along with others. Spouse and family were killed in a car accident.

Promotion/Demotion Cards

Is a very good worker. Takes charge when the boss is away. Takes too long lunch break but, for all the work done, deserves it.

Has been a good worker but does not get along with other workers. Has been in a few verbal fights with the boss but has been working hard and gets things done.

Has been sick 20 days over the seven day limit. Has developed a bad heart. Gets most work done on time and accurately. Has come to work drunk a couple of times.

Has done job well. When there are problems takes care of them. Has missed a few days because of illness. Saves a lot of money by conserving energy. Doesn't get along with other workers.

Has been coming to work late and leaving early. Doesn't get work done on time. But when works, gives 100%.

Has done an excellent job when at work. Misses many Fridays. Could hold better job. Apathetic.

THE WORK PROCESS

Role-play interviewing for a job through a personnel game, and receive either a raise or a demotion through the draw of a card; then fill out an evaluation sheet to help you realize the importance of the work process.

Challenge Statement

Often there are fewer jobs than people who need them. It is important to know how to interview for a job when you are competing for work in the marketplace. Once you have work, you must be responsible and capable to keep it. Employers cannot afford to keep incapable employees.

Teaching Objectives

- To understand the elements of the hiring process
- To become aware of the types of training opportunities of the personnel system
- To understand the elements of the working system
- To know the elements of the positioning process
- To understand the elements of the retiring process

Vocabulary

- Qualified
- Recruiting
- Inducting
- Apprenticeship
- Positioning
- Demoting
- Counseling
- Hiring
- Selecting
- Training
- Seminar
- Discharging
- Advancing
- Retirement

Equipment/Supplies

- Application Form
- Contract Form
- Personnel Cards
- Promotion/Demotion Cards

Introduction

The personnel system forms an outline of a person's work life. The first element is the *hiring* process. *Recruiting* is attracting a needed employee. *Selecting* through the interviewing process matches the job requirements with the most qualified applicant. *Inducting* gives new employees a knowledge of the company.

The second element is the *training* process. *Apprenticeship* is a type of training program for highly skilled jobs. *Seminars* are designed to help management people in leadership positions.

The third element is the *working* process. Economic rewards are wages, salaries, or fringe benefits. Physical working environment includes lighting, air quality, and safety equipment. The social working environment is the attitude, beliefs, language, social functions, and intelligence of the people with whom you work.

The fourth element is the *positioning* process. Advancing or *promoting* is moving to a new level of responsibility where more will be expected of you, and you will probably be paid more. Discharging is firing. *Demoting* is moving to a level of less responsibility and usually less pay.

The fifth element is the *retiring* process. Most people retire at age sixty-five after many years of service with a company. Counseling helps clarify plans for retirement and adjustment. Recognizing service may include a banquet or office party to say "good-bye" to a worker.

Procedure

1. Obtain a Personnel Card from your instructor. Be prepared to answer the following questions at the end of the Personnel Game:
   a. Did you get hired?
   b. How much did you get paid?
   c. What did the personnel managers look for when interviewing you?
   d. Did you get fired or promoted?
2. Fill out an Application Form based on the Personnel Card. Participate in role playing the interviews. Complete the Contract Forms.
3. Select a Promotion/Demotion Card. Discuss it with your personnel manager as an evaluation process in a real work situation.
4. Complete the Evaluation Sheet, and turn it in to your instructor.
5. Participate in the discussion of the various interviews. Apply the information to your own personal career goals.

Evaluation

You will be evaluated on your participation in the Personnel Game and your degree of understanding of the process from your answers on the Evaluation Sheet. The test is available for an objective grade, if your teacher desires.

Technology Activity Challenges

1 Designing an Environmentally Friendly Milk Carton

Activity Challenge: The learner will evaluate currently used milk containers for advantages and disadvantages for our environment.

Students will design an environmentally friendly milk container with all the advantages of our current containers and none of the disadvantages.

Resources: Milk containers, drawing materials, and packaging materials

Processes: Packaging and materials evaluation, design, and construction

Application: Packaging, recycling, environmental concerns

Impact: Career opportunities, environmental consciousness

2 Advertising—Design

Activity Challenge: The class will be divided into groups. Each group will be given the same black and white sketch of a scene that could be used to advertise a product. The group must determine (1) the focal point of the ad, and (2) a means to emphasize the focal point. The group can use color, pop-ups, computer enhancements (any method available) to accomplish their goal. Each group will present their ad. The class will evaluate each ad and compile a list of methods used to catch the eye of the consumer in marketing a product.

Resources: Black and white sketch, colored paper and markers, CADD/CAM

Processes: Design and marketing

Application: Designing advertising

Impact: Consumer awareness

3 Zoning a Model Community

Activity Challenge: A large corporation is going to build a manufacturing plant 50 miles outside of a major city in an uninhabited area. They will employ 6,000 people and want to design the new town as a model community.

Students will form groups to brainstorm all the needs of a community, including necessary services and businesses. They will design a model community, appropriately zoned, to accommodate the growing town.

Resources: Problem statement, drawing tools, CADD, if available

Processes: Brainstorming, planning, designing

Application: Construction, community zoning

Impact: City planning

4 Ergonomics

Activity Challenge: As we learn more about human nature, the body, and comfort, designers are focusing on ergonomics, which is designing tools and equipment to form to the human body. We see it in adjustable seats in cars and sculptured steering wheels and tools.

The students will design a piece of furniture or tool as an ergonomist.

Resource: Drawing tools and equipment, ergonomic reference materials from the library

Processes: Research, design

Application: Design skills, human comfort

Impact: Design and marketing

5 Base Maps for Residential Planning

Activity Challenge: Students will be given an aerial photograph of an area to be developed. They will produce a base map of a residential community with overhead shapes and sizes of homes, including landscaping, using a CADD system. They will cut and paste their option on the aerial map.

Resources: Aerial photograph, CADD system

Processes: Planning, design, and computer skills

Application: Community planning, mapping, land use

Impact: Environmental concerns, careers, community planning

6 The Evolution of Manufacturing

Activity Challenge: Students will use the following information to understand the evolution of manufacturing. They can work in groups to research individual eras, then cooperatively teach or tackle the entire evolution.

1940	Manual Drawing	Skilled Workforce	Manual Machinery
1960	Engineering Drawings	NC Tape Programs	NC Machines
1980	CAD/CAM	CNC Manufacturing	
2000	?		

Students will then project "manufacturing of the future."

Resources: Encyclopedias, text, applicable reference materials

Processes: Research, writing, reporting, imagining

Application: The past and future of manufacturing

Impact: The future of technology, understanding the evolution of technology

7 Pneumatic Conveyor Systems

Activity Challenge: Students will research the use of pneumatic conveyance since its inception in 1866 to the present; design and build a small pneumatic conveying system; evaluate and analyze the systems; and draw conclusions about pneumatic transport.

Resources:	Reference materials, drawing tools, common woodworking tools and equipment, plastic pipes, joints, adhesives, and an air source
Processes:	Research, design, construction, testing and evaluating, drawing conclusions
Application:	Pneumatic conveyance
Impact:	Design, problem solving, pneumatic transport

8 Kite Production

Activity Challenge: Students will design a simple, but marketable kite, compile a bill of materials, complete a flowchart, and construct and test their design. They may work in groups or individually.

Resources:	Drafting materials, paper for bill of materials and flowcharts, hand tools, kite-making materials
Processes:	Designing, planning, constructing, testing, evaluating
Application:	Manufacturing processes
Impact:	Industry, careers

9 Future Robots

Activity Challenge: The class will divide into groups. Each group will brainstorm the future role of robots for personal use or in industry. One member of the group will role-play the robot. The class will list the functions the "robot" performed and determine if they are possible robot functions. They must use proper robotics terminology. If the function is not possible, they must determine what technological developments would be necessary to make the function possible.

Resources: Students, information on robots (text)

Processes: Imagining, presenting, evaluating, projecting

Application: Industrial and personal robotics

Impact: Creative imagining, robots design

10 Elements of Design

Activity Challenge: Students will consider the five elements of design—line, shape, form, texture, and color, and how they affect our purchases. Students will draw a chart including the five elements and rate given products according to their likes and dislikes. The products can be food items, clothing, tools, automobiles. Get an average of each item to determine consumer preferences.

Resources: Assorted products, preference rating chart

Processes: Evaluating, selecting, averaging, drawing conclusions

Application: Consumer preferences, design

Impact: Marketing, design, packaging

11 Industry and the Environment

Activity Challenge: Students will brainstorm at least ten things industry can do to contribute to recycling, reuse, and conservation. Compile as many points as possible, and compare with other classes.

Write to major industries requesting information on conservation, recycling, and reuse efforts. Ask, "What are you doing to protect the environment?"

Resources: Paper and pen or word processor

Processes: Brainstorming, letter writing

Application: Recycling, conservation

Impact: Social responsibility toward the environment

12 Strength-to-Weight Ratio

Activity Challenge: Each student will receive one sheet of heavy paper to fold and shape into a load-bearing block. To determine the strength of the block, you will put an empty coffee can on the block and slowly add sand. Stop pouring sand when the block gives. Weigh the sand to determine the load. Have the student repeat the process with another piece of paper. Did the load increase? Have the students make deductions about strength-to-weight and structure.

Resources: Heavy paper, coffee can, sand, scale

Process: Block construction, observation, experimentation, making deductions

Application: Construction

Impact: Structural stability in construction

13 What Do You Want to Be When You Grow Up?

Activity Challenge: Students will list ten interests. From the list they will identify one common interest. Students will review the *Occupational Outlook Handbook* for a career or occupation that interests them, then list the training necessary for the career and set up goals to achieve a position.

Resources: Paper, pencil, and *Occupational Outlook Handbook* or career reference books

Processes: Self-evaluation, research

Application: Career choices and goals

Impact: School achievement and careers

14 Current Developments in Production and Construction

Activity Challenge: Students will research current developments in production and construction. They will call local industries and inquire about innovative processes, materials, or designs, and they will cooperatively teach the information they receive. They will make models of new innovations.

Resources: Current technological publications, phone books, modeling materials

Processes: Research, cooperative teaching, model building

Application: Innovative technology, careers

Impact: Career choices, technology appreciation

15 Creative Problem Solving

Activity Challenge: The class works in groups. Each group devises a production or construction problem. The problem statement is given to each group to work through to a solution. Each group presents their solution to each problem. The students practice the problem-solving method and realize there is more than one solution to every problem.

Resources: Paper, pen/pencil

Processes: Creative problem solving, teamwork, evaluation

Application: Ongoing problem solving, production and construction

Impact: Problem-solving competency

16 From Raw Materials to Distribution

Activity Challenge: Students will choose a CD disc, audiocassette, or record album to analyze. They will identify the pieces of the total product at sale, including labels and plastic wrapping, break down each piece to raw products, determine manufacturing processes of production for each piece, determine the jobs necessary to bring the product from raw material to the consumer, review planning processes, project distribution, and share the information with the other groups.

Resources: CD disc, audiocassette tape, record album, pencil and paper

Processes: Research, analysis, brainstorming, presenting

Application: Familiar product analysis

Impact: Product appreciation, manufacturing awareness

17 Soundproofing

Activity Challenge: Students will be presented a hypothetical situation which requires a soundproof room. They will study acoustical materials and wall structures and build a model of a wall section.

Resources: Current technology publications, acoustical materials, construction materials

Processes: Research, model building

Application: Construction, custom design

Impact: Construction

18 Informative Packaging

Activity Challenge: Students will study a package for a common product and list the information on the package. They will determine why the information is given, then design a package for an imagined product. They will analyze the new packages and discuss manufacturers' responsibility to consumers.

Resources: Packages from common products, paper, pencil

Processes: Analysis, design, brainstorming

Application: Manufacturing, design

Impact: Responsible manufacturing, consumer awareness

19 Presenting a Company Image

Activity Challenge: Students will determine a hypothetical product for manufacturing, and design the PR to go along with the company's image. They will design a logo, a sign, emblem for uniforms, and stationery.

Resources: Newspapers and magazines

Processes: Imagining, design

Application: Public relations, marketing

Impact: Consumer awareness, marketing

20 Designing and Building a Compression Tester

Activity Challenge: Students will build a compression tester using a hydraulic jack. They will test three concrete samples and compare the results with the manufacturer's recommended compression ratings.

Resources: Hydraulic jack, materials for compression tester as designed, concrete

Processes: Design, construction, experimentation, evaluation

Application: Concrete construction

Impact: Basic construction skills

21 Wiring an Outdoor Playground

Activity Challenge: Students will design an outdoor play area focusing on exterior wiring. They will list local and state codes for exterior circuits, explain the effects of water and moisture on circuitry, explain the differences between indoor and outdoor electrical materials, and detail safety precaution to be built into wiring in a play area.

Resources: Design and drafting equipment

Processes: Design, research, presentation

Application: Design skills, construction knowledge

Impact: Construction

22 Basic Wiring

Activity Challenge: Students will draw a diagram of a branch circuit in a 110-volt circuit that is controlled with a single-pole switch. They will write a verbal description of the operation.

Resources: Drafting tools and supplies

Processes: Drafting, electrical design and analysis

Application: Electrical wiring, basic construction

Impact: Construction

23 Typical Residential Wiring

Activity Challenge: Students will wire a model of a functional 110-volt circuit that has a branch controlled by a set of three-way switches and a circuit branch that has a single-pole switch controlling a split circuit duplex outlet.

Resources: Wiring materials

Processes: Residential wiring, modeling

Application: Electrical wiring

Impact: Construction

24 High-Tech Adaptations

Activity Challenge: Students will evaluate a completed production lab activity using the process flowchart. They will divide into groups, and each group will determine how the flowchart can be adapted using robotics and CNC. The students will compare adjustments. The class will evaluate each proposal and determine the ideal, high-tech flow of operations.

Resources: Previous process flowcharts

Process: Evaluation, research robotics and CNC, transference

Application: Modern industrial processes

Impact: Industry, CNC, robotics

25 Developing the Atom

Activity Challenge: Work with a science teacher to trace the atom from discovery. Science students will prepare models and posters to explain the atom and its basic function. They will present this information to technology students. Technology classes will research technological advancements in energy production, the military, and the medical industry. They will prepare informative posters to present to science classes.

Resources:	Reference materials, current technology publications, presentation materials
Processes:	Research, gathering and presenting information
Application:	Science and technology
Impact:	Technology development

26 Time and Motion

Activity Challenge: Set up a number of processes (cutting, drilling, routering, sanding). Time two groups of students performing the operations with hand tools, two other groups completing the same task using hand-held power tools, and two other groups using fixed equipment. Chart the time required in each group. Discuss the development of tools and machines. Contrast fixed equipment with robotics and computer controlled machines. Project equipment of the future.

Resources:	Hand tools, hand-held power tools, fixed equipment, graph paper, stopwatch
Processes:	Various machine operations as appropriate for your facility, evaluation, comparisons, deductive reasoning, projection
Application:	Developing technology
Impact:	The future of machine processes and equipment

27 Construction Planning

Activity Challenge: Invite an architect or contractor to present the construction planning process to your class. Ask him or her to bring plans from a completed project (one the students could see) and to describe the process from design, preparing the plot, hiring the workers, to selling. With planning, you may contact a presenter at the onset of the project and take slides for him/her to present to the class on completion.

Resources: Architect or contractor

Processes: Observation and questioning

Application: School to real-life career

Impact: Construction and career choices

28 Measurement and Layout

Activity Challenge: Give each student a handout with the layout of building materials drawn to scale. Present a plan for a piece of furniture, with dimensions. Each student will identify the individual furniture pieces and sketch the proper layout on the handout. The students may use map pencils to indicate the pieces. Evaluate layout on best use of materials. The students can only use the materials on the handout.

Resources: Scale, handout, transparency of construction piece

Processes: Evaluation, measurement, synthesis

Application: Drafting and construction

Impact: Material use, construction

29 Temporary Shelter

Activity Challenge: Olympic competition brings thousands of people into already populated areas for a short period of time. They need housing during their stay. Students will work in groups to design comfortable, high-density, reusable housing. They will draw their ideas and build a model of a shelter.

Resources: Drafting tools and equipment, model-making materials

Processes: Designing, engineering, model making, evaluation

Application: Design, construction

Impact: High-density, temporary housing

30 Creative Architecture

Activity Challenge: This activity requires the cooperation of math classes. The math students will construct blocks of different geometric shapes and sizes from heavy paper. Each technology student will be given six to eight blocks to construct a building. After the building is constructed, the students will draw a floor plan detailing the rooms and their uses. Technology students will return the buildings and floor plans to the math class to analyze.

Resources: Heavy paper, tape glue, drafting tools and supplies

Processes: Measuring, design, imagining, drafting

Application: Math, technology, construction

Impact: Creative architecture and design

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964: EXECUTIVE ORDERS 11246 and 11375; TITLE IX 1973 EDUCATION AMENDMENTS: REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974.

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulation by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs of activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except where age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups.